Materials & Methods

JULY
1953

How to Tell Quality in Teflon

High Strength Precision Iron Powder Parts

Surface Contamination and Quality in Titanium

Simplified Ball Bearing from Steel Tubing

Ultrasonics—The Answer to Aluminum Soldering?

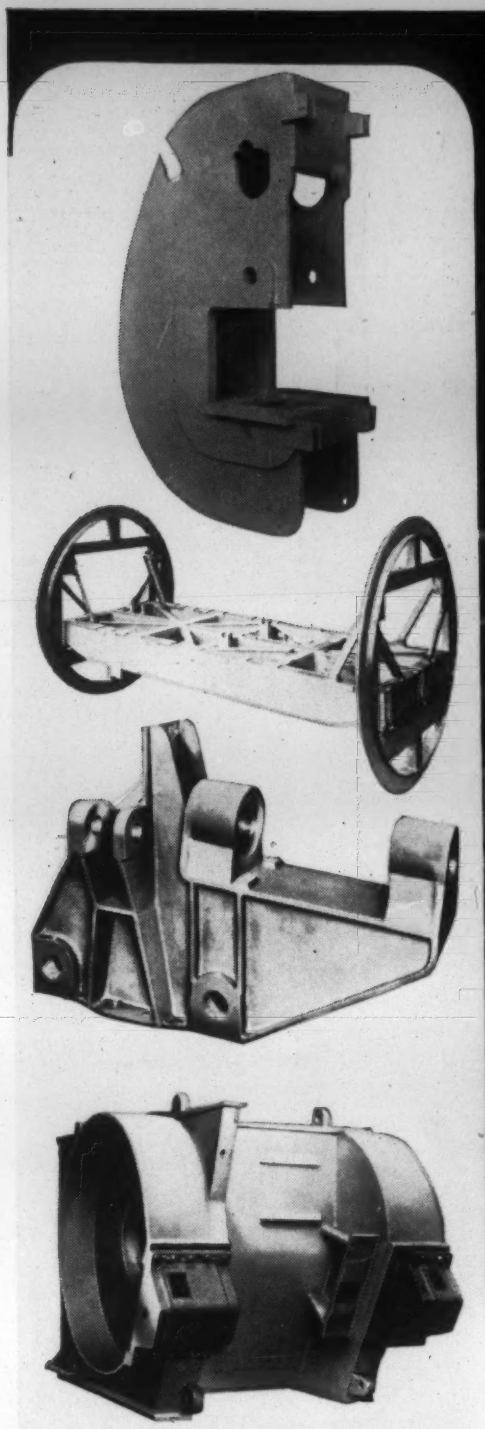
Precision Rolled Thin Strip

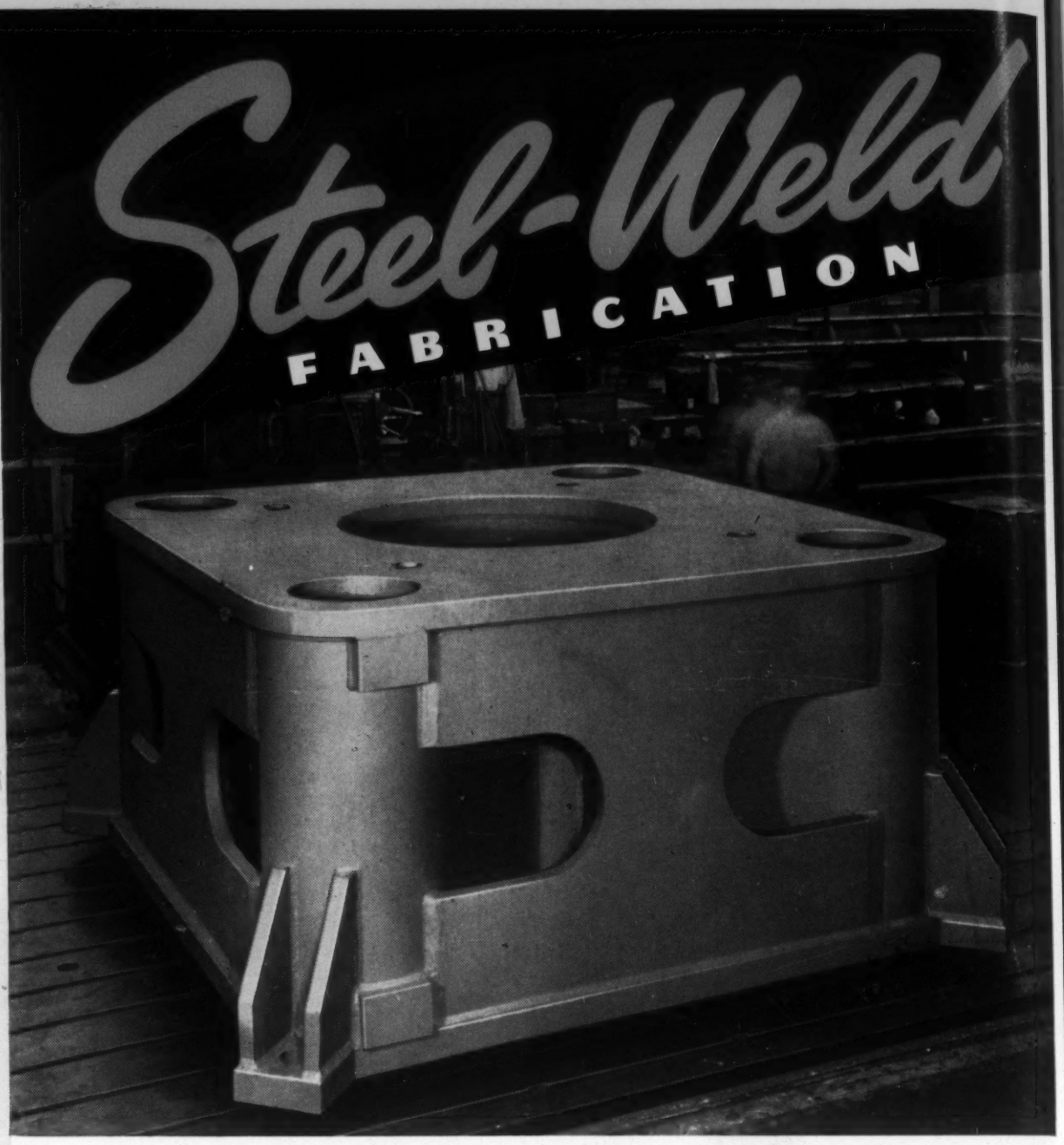
How Section Size Influences Properties of Sand Castings

Annealing Type 414 Stainless Steel Forgings

RUBBER PARTS
—Materials & Methods Manual No. 95

THE MAGAZINE OF
MATERIALS ENGINEERING
DEVOTED TO THE MATERIALS PROBLEMS OF PRODUCT DESIGN AND MANUFACTURE





Use WELDED STEEL for Greater Strength with Less Weight!

Illustrated above is a twenty-two ton Moving Cross-Head for a 2500 ton Press. This and other units illustrated at the left are typical of thousands of Steel-Weld Fabricated parts and assemblies produced and machined by Mahon for hundreds of manufacturers of heavy machines and equipment. If parts of your product could be redesigned and produced to better advantage through Steel-Weld Fabrication, or, if you require a limited number of large heavy pieces, in which pattern costs are a consideration, you can turn to Mahon with complete confidence . . . personnel and facilities are available within the Mahon plant to do the complete job from drawing board to finished machining. You will find in the Mahon organization a unique source with complete ultramodern fabricating, machining and handling facilities to cope with any type of work regardless of size or weight . . . a source where skillful designing and advanced fabricating technique are supplemented by craftsmanship which assures a smoother, finer appearing job embodying every advantage of Steel-Weld Fabrication. See Mahon's Insert in Sweet's Product Design File, or write for further information.

THE R. C. MAHON COMPANY
DETROIT 34, MICHIGAN

Engineers and Fabricators of Steel in Any Form for Any Purpose

MAHON

Materials & Methods®

THE MAGAZINE OF MATERIALS ENGINEERING • VOL. 38, NO. 1 • JULY, 1953

WILLIAM P. WINSOR, Publisher

T. C. DU MOND, Editor H. R. CLAUSER, Managing Editor

JOHN L. EVERHART, Associate Editor
GIL MILLER, Art Director

KENNETH ROSE, Mid-Western Editor
111 W. Washington Street, Chicago

JOHN B. CAMPBELL, Associate Editor
FRED P. PETERS, Editorial Consultant

FRANK J. ARMEIT, Production Manager

JOHN Y. CUNNINGHAM, Promotion Manager

JOHN N. CARLIN, Circulation Manager

E. M. WOLFE, Manager, Reader Service

Feature Articles

Ultrasonics — The Answer to Aluminum Soldering? . . . . . *Leo Walter* **59**
English development permits fluxless soldering. Gives satisfactory results in repairing castings

Simplified Ball Bearing Fabricated from Steel Tubing . . . . . *E. W. Batterson* **62**
Lower grade materials prove successful for bearings for low speed, light load uses

How to Tell Quality in Teflon . . . . . *I. D. Press* **64**
Difficulties such as spotting, porosity and dimensional instability are traced to source

High Strength Precision Iron Powder Parts . . . . . *W. J. Doelker and H. T. Harrison* **67**
Sinterings now finding use for many parts requiring high strength properties

Surface Contamination and Quality in Titanium Fabrication . . . . *V. C. Petersen* **72**
How cold forming properties are adversely affected by surface impurities

Materials at Work **74**
Continuous Cast Bronze • Electroless Plated Pump • Rubber Bearing-Type Seal

Annealing Type 414 Stainless Steel Forgings . . . . . *Anthony A. Scafati* **78**
Two-stage procedure gives optimum hardness and machinability

How Section Size Influences Properties of Sand Castings . . . *W. J. Reichenecker* **80**
Working curves help engineer and designer select proper alloy and thickness

What Precision Rolled Thin Strip Has to Offer . . . . . *A. I. Nussbaum* **82**
This specialty stock simplifies miniaturization problems, lowers finishing costs

Furan Resin Impregnants for Plaster . . . . . *J. Starr* **111**
They increase strength and durability of low cost plaster castings

Materials & Methods Manual No. 95

Rubber Parts . . . . . *Philip O'Keefe* **85**

Engineering File Facts

Manganese Steels (No. 256) **105**
Properties of Electrical Insulating Materials (No. 257) **107**

Departments

The Materials Outlook . . . **3**
News Digest **6**
Briefs **11**
New Materials & Equipment . . **111**
Meetings & Expositions . . . **192**
Materials Reports **194**
Book Reviews **198**
Manufacturers' Literature . . **203**
Advertisers and Their Agencies **218**
The Editor's Page **220**

Published monthly by Reinhold Publishing Corporation, 330 West 42nd Street, New York 36, N. Y.

RALPH REINHOLD, Chairman of the Board
PHILIP H. HUBBARD, President & Treasurer
K. A. STARKE, Assistant Treasurer
F. P. PETERS, Vice President & Secretary
G. E. COCHRAN, Vice President
H. BURTON LOWE, Vice President
MERALD LUE, Vice President
WILLIAM P. WINSOR, Vice President

Price 50 cents a copy. Payable in advance, one year $2.00; two years, $3.00; three years, $4.00 in U. S. Possessions and Canada. In all Latin American countries: one year $10.00; two years, $16.00; three years, $20.00. All other countries: one year $15.00; two years, $25.00; three years, $30.00 (Remit by New York Draft.)

Copyright, 1953, by Reinhold Publishing Corporation.

Printed by Publishers Printing Co., New York, N. Y.

All rights reserved.

Reentered as second class matter July 19, 1951, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Established in 1929 as Metals and Alloys.

Another new development using

B. F. Goodrich Chemical *raw materials*

This Geon vinyl sponge developed in B. F. Goodrich Chemical Co. laboratories

How to pack a Fragile Baby!

THE cost of damage to electronic or other sensitive instruments in shipping is high, so that special packaging is needed to guard against such injury. See how well this new Geon vinyl sponge does the job!

It can be molded to fit the shape, for exact and firm "holding". Then, with a top layer of the sponge, the instrument is completely and safely covered. No extra wrapping is needed.

Because this Geon vinyl sponge is resilient and shock-resistant, it cushions instruments against damaging bumps and jars. And because the sponge is made of Geon, it also resists aging, alkalis, oils, greases and many chemicals. A material that has wide possibilities for packaging optical instruments, electrical equipment and other fragile objects!

Perhaps this use of Geon may start you thinking how a Geon material—resin, plastic granules or latex—may help you solve a problem, develop or improve more saleable products. We'll help with technical advice, aid you in selecting the Geon material best suited to your needs. For information, please write Dept. GN-4, B. F. Goodrich Chemical Company, Rose Bldg., Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

GEON RESINS • GOOD-RITE PLASTICIZERS . . . the ideal team to make products easier, better and more saleable.

GEON polyvinyl materials • HYCAR American rubber • GOOD-RITE chemicals and plasticizers • HARMON colors

The Materials Outlook

A new electroplate claimed to be as resistant to tarnishing as chromium and more attractive in color is commercially available. It is a 65 tin-35% nickel alloy. The alloy plate is considerably harder than either of its constituents. Developed in England, the plating process is said to be little more complicated than a single metal plating operation, the composition of the plate remaining quite constant despite changes in operating conditions. The new plate is claimed to be capable of replacing nickel-plus-chromium on a thickness-for-thickness basis.

Also in England, a new group of aluminum-tin bearing alloys is being developed as an alternative to copper-lead. Containing 30% or more of tin, these alloys are softer than the copper-lead materials and are claimed to have good fatigue properties. Versatility can be increased by addition of copper.

Another bearing material, being studied in Germany, consists of sintered iron powder infiltrated with sulfur. Such bearings can be used under high loading or high rotational speeds, at elevated temperatures, for continuous operation when the danger of closing the pores exists, where solvents for organic lubricants are present, and in other places where routine lubrication is impossible. A corrosion-inhibiting action is also claimed.

In figuring the cost of sprayed organic coatings, don't overlook a new method of application rapidly taking hold - steam spraying. Using steam instead of air as the propellant is likely to save money because of: 1) material savings of 10 to 20%, 2) increased film thickness in some cases, 3) less reducing thinner needed, 4) fewer cleanings of spray booth needed, and 5) steam is often cheaper than compressed air. However, not all finishes can be applied successfully by this method, and some work better if they are modified for the steam process.

A copper price as low as 26 or 26½ cents a pound by the end of the year is seen by market dopesters. Main reason is the influx of foreign copper. However, some experts believe that the government's apparent decision to continue support of foreign currencies may make U. S. dollars less attractive, and the foreign copper might be diverted to other markets.

If you're having trouble getting seamless brass tube and pipe, remember that DMS requires that 55% of the production be set aside for defense orders. Up to 40% of copper-alloy rod, bar, shapes and wire is being reserved, and from 15 to 30% of other copper and copper-alloy mill products.

(Continued on page 4)

The Materials Outlook *(continued)*

Less aluminum will be available in this quarter. Imports from Canada have dropped and more is going into the national stockpile. The decline, however, will probably amount to only 2 to 3%. About 33% of total aluminum production is being set aside for defense orders.

New uses for silicones are still being found. Silicone foam is now available. Silicone-glass pressure sensitive tapes are nearing commercial reality. Laboratory tests seem to indicate that silicone-based protective coatings can be made much more solvent resistant than heretofore. . . . The possibilities are so broad, in fact, that a third major producer of silicones will shortly enter the field.

The silicone adhesive, incidentally, promises to be unusually versatile. It retains high adhesive strength at temperatures ranging from −55 to over 300 F. It tends to soften at higher temperatures, but still retains good pressure sensitivity and adhesion after long exposure at 400 F. (Adhesive strength is greatly increased by a 5-min cure at about 480 F.). . . . And all this from a family of materials which has produced an anti-sticking resin for mold release applications.

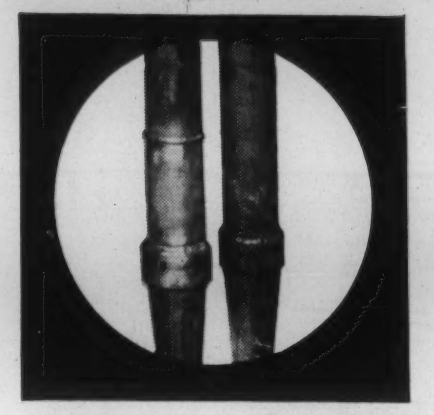
Another silicone product not yet available commercially is silicone-asbestos-glass slot liner. The silicone resin-bonded glass-mica-glass laminate now being used in Class H electrical equipment can't take cold forming. The new material, substituting asbestos for mica, is claimed to overcome this difficulty.

Solid zirconium plate, ⅝ in. thick and weighing 1000 lb, has been successfully rolled. Zirconium-clad steel has been produced experimentally. But it will be a long time before civilian industry sees much of either. . . . A new clad metal now commercially available is copper on steel. Other clad metals still in the experimental stages include tantalum, aluminum and Hastelloy F - all on steel.

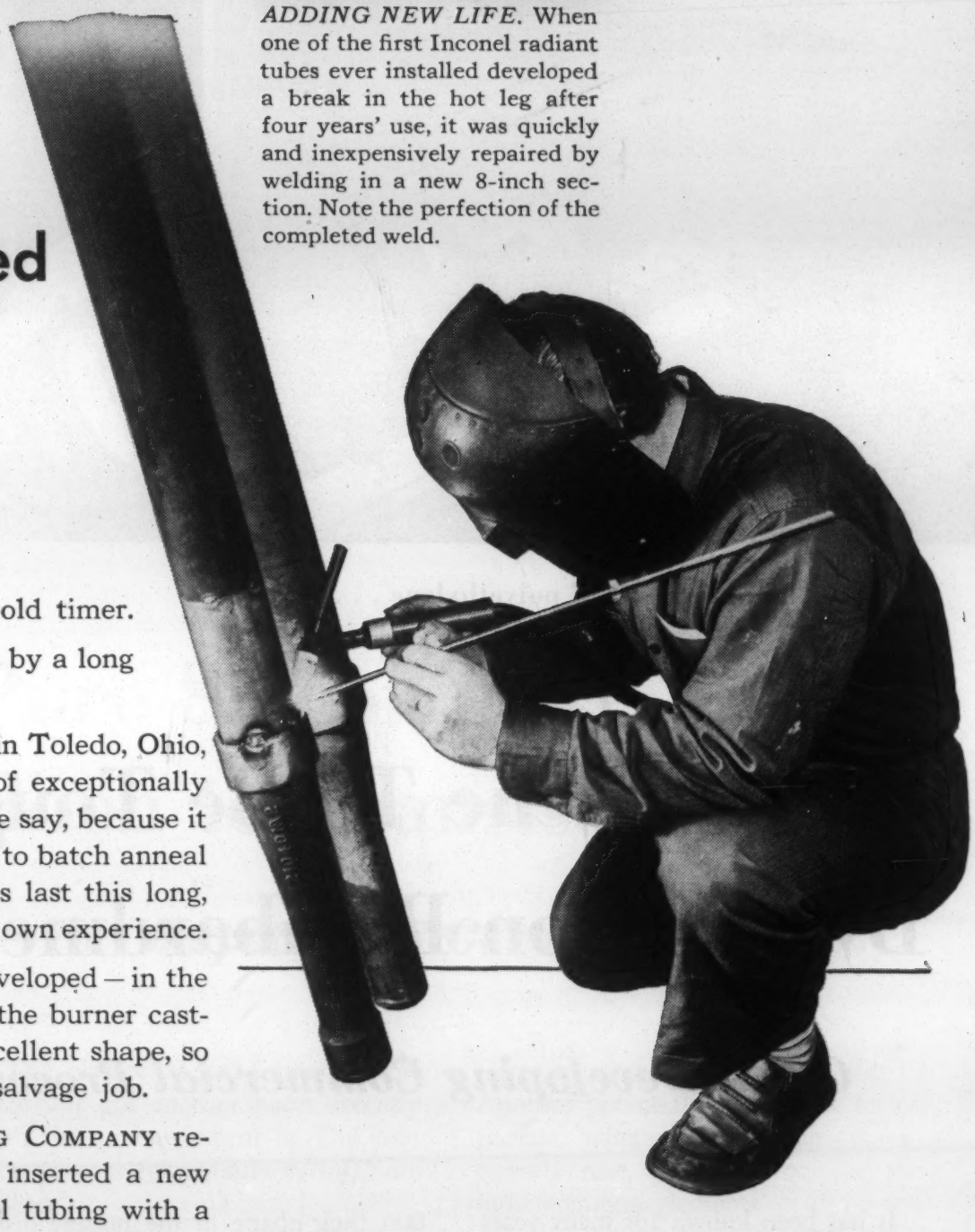
Porcelain enameling of assembled structures is now possible as a result of the development of a hand spray-gun which shoots the ceramic through an acetylene torch, fusing it to the steel surface. Ordinarily applying and firing porcelain enamel are two separate operations, but this method combines them, eliminates the need for furnaces and makes this type of coating more widely applicable. The process is still being tested.

Phenolic glass low-pressure laminates, being touted in some quarters as a heat-resistant material, may also find more ordinary applications in competition with polyester-glass. Recent improvements in fabricating characteristics are leading some designers to take another look at the greater strength of the phenolics. Inability to use pastel colors with the phenolics is still an important limitation, however. . . . Advent of phenolic-glass molding materials which can be formed at much lower pressures than before may also enable the phenolics to cut in on some of the expanding "large plastics moldings" business.

A veteran of 15,000 hours at 1,650° F reconditioned for only $22.50!



ADDING NEW LIFE. When one of the first Inconel radiant tubes ever installed developed a break in the hot leg after four years' use, it was quickly and inexpensively repaired by welding in a new 8-inch section. Note the perfection of the completed weld.



This Inconel® radiant tube is an old timer. But it isn't on its last legs yet—not by a long sight.

At the ELECTRIC AUTO-LITE plant in Toledo, Ohio, the tube racked up 15,000 hours of exceptionally good service. Exceptionally good, we say, because it operated in a pit-type furnace used to batch anneal small parts at 1,650° F. Few tubes last this long, as you've probably found from your own experience.

After four years, a break finally developed—in the firing leg near the welded joint at the burner casting. The rest of the tube was in excellent shape, so Auto-Lite engineers decided on a salvage job.

Toledo's INDUSTRIAL FABRICATING COMPANY rebored the old burner casting and inserted a new 8-inch section of 3½" OD Inconel tubing with a wall thickness of .109". Using an inert gas shielded arc welding process and "62" Inconel Filler Wire, they joined the new section to the original casting. Then they butt-welded this assembly to the old Inconel tube.

All it cost was $22.50—and Auto-Lite has a reconditioned Inconel radiant tube that's ready for many more hours of service.

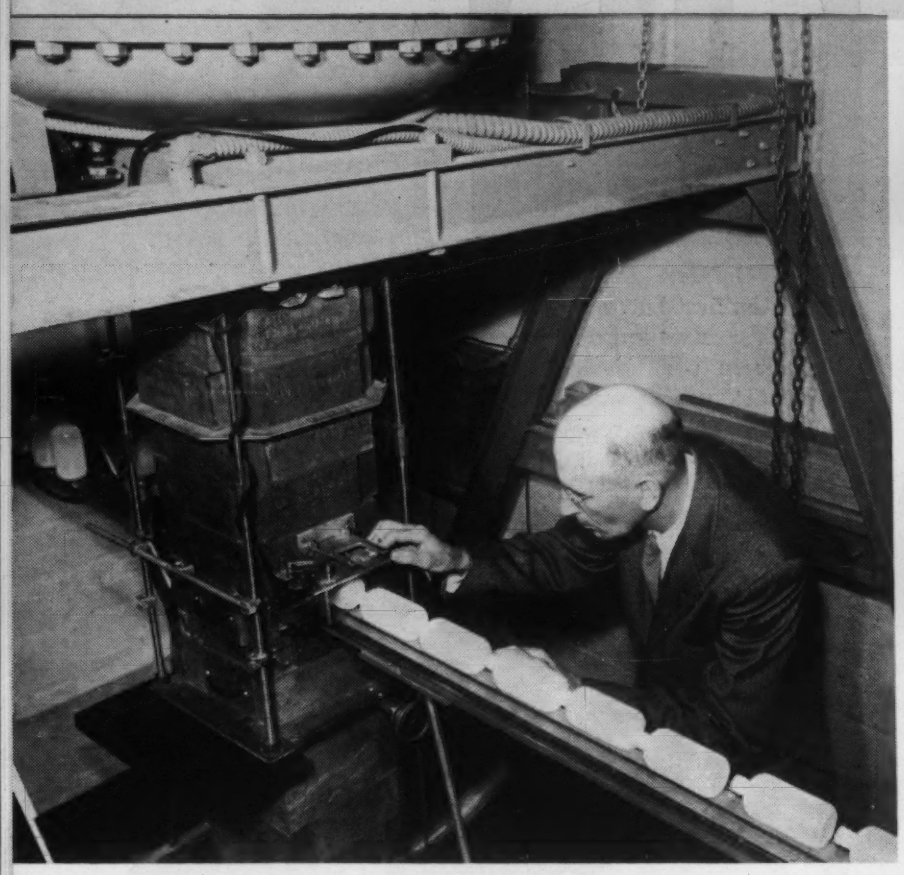
Reports of salvage operations on Inconel wrought furnace and heat-treating equipment are not unusual, for Inconel is one of the most durable high-temperature metals available. Highly resistant to corrosion, embrittlement and destructive oxidation, Inconel serves dependably at temperatures up to 2,200° F. Inconel welds are as heat-resisting and as corrosion-resisting as the alloy itself.

You'll find a great many additional facts about this important alloy in the bulletin, ***Inconel, Workhorse for High Temperatures.*** Your copy is ready and waiting. Write for it now. And consult your distributor of Inco Nickel Alloys for the latest information on availability from warehouse and mill. Remember, too—it always helps to anticipate your requirements somewhat in advance. The International Nickel Company, Inc., 67 Wall St., New York 5. N.Y.

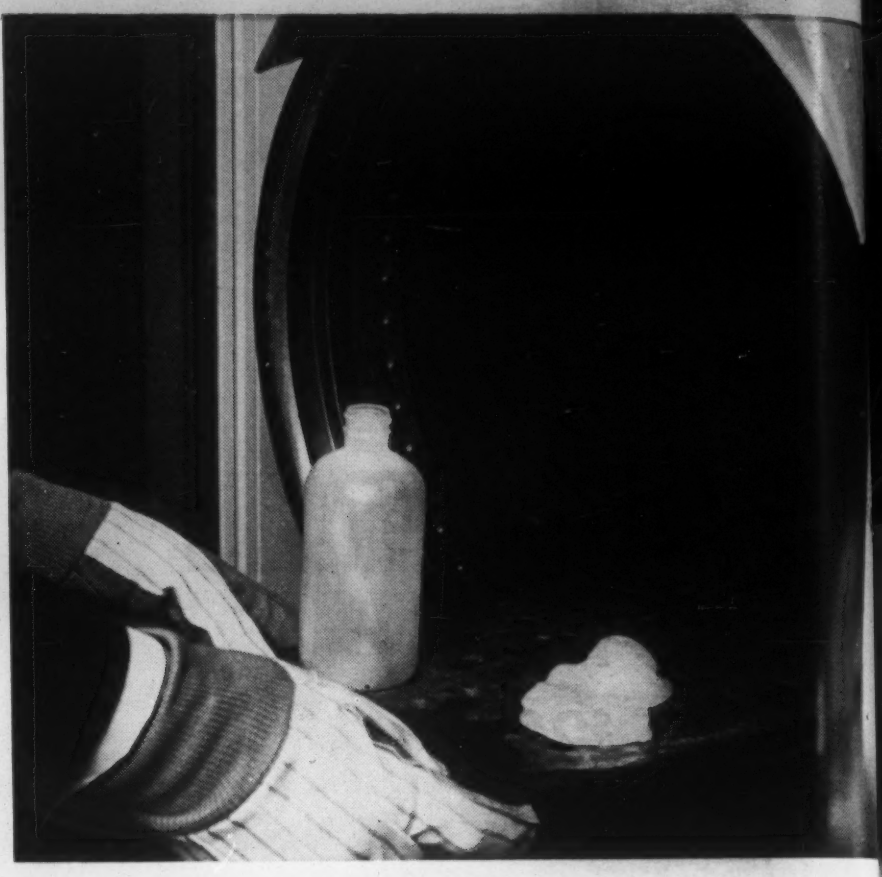
Inco Nickel Alloys

Inconel

...for Long Life at High Temperatures



Electron bombardment of polyethylene . . . .



. . . makes a difference at 250 F.

Polyethylene To Be Toughened By Electron Bombardment

G-E Is Developing Commercial Process

It has been known for many years that plastics could be cured by bombarding them with high-energy electron beams. Now, for the first time, this technique seems to be gaining some commercial interest.

According to Dr. C. G. Suits, General Electric vice president and director of research, a few seconds' bombardment with electrons from a million-volt X-ray machine makes polyethylene bottles stand up under steam-sterilization. This toughening he says, will permit more widespread use of these containers for packaging and storing pharmaceuticals and biological fluids.

"It now appears that polyethylene dishes exposed to electrons will retain their shape in the hottest dishwashers," he adds. "Exposure to the powerful electron beam substantially raises the flow temperature of these plastics.

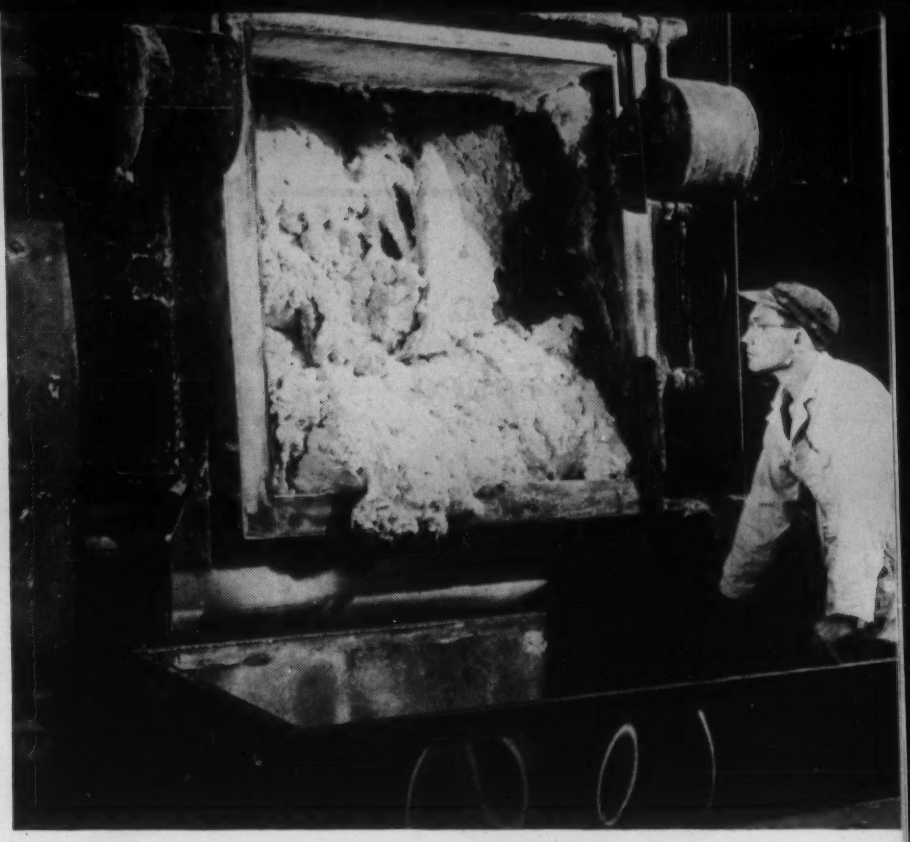
"This toughening process also increases the resistance of plastics to destructive action of many solvents. Before the 'curing' process was perfected, many plastics disintegrated in contact with such solutions."

The electron beam is produced by removing the tungsten target from a million-volt resonant transformer-type X-ray apparatus and shooting the electrons out a small metal foil window. In most cases, 15 seconds' exposure is enough to toughen the plastics.

Essentially the "curing" process cross-links the long, chain-like molecules called polymers which make up these plastics. It also looks like it will be possible to control the pattern of the electron beam so that only selected portions of the object are changed. This might make possible several new ways of forming plastics.

The process, now in the hands of GE's Chemical Div. at Pittsfield, Mass., was the outgrowth of other work with the electron beams. Other techniques investigated include the selective solidification of liquid substances and the depolymerization of natural products such as cellulose and wood.

Measuring Thickness A Beta Ray Gage is being used to measure the thickness of coated tin plate on the new electrolytic line of U. S. Steel's Columbia-Geneva Steel Div. Off-gage material is automatically diverted at the end of the line.



Silicone Rubber Anticipating increased demand for silicone rubber, Dow Corning Corp. recently boosted its productive capacity by 500,000 lb of Silastic per month. The new facilities are housed in what is said to be "the largest silicone rubber plant in the world" in Midland, Mich.

Cheaper Stainless Around Corner?

A ferrochrome alloy containing virtually no carbon is now being produced at Marietta, Ohio, by Electro Metallurgical Co., a division of Union Carbide and Carbon Corp. Ultimately, this may mean lower prices for stainless steels.

Now undergoing extensive tests throughout the steel industry, the new alloy is expected to help broaden the applications of stainless steels and to increase their effectiveness in many critical uses such as atomic energy applications, various types of chemical equipment and jet aircraft.

The new alloy, called Simplex ferrochrome, is made in the form of pellets about the size of a walnut. It is claimed that carbon content can be kept as low as 0.01% and that the pellets can be melted more rapidly than conventional grades of ferrochrome.

Developers of the process think it should bring about economies in the production of the extra-low-carbon stainless steels because of faster furnace operation; and also make it possible to obtain greater overall recovery of chromium in the production of all grades of stainless steels.

Pure Silicon Here— Boon to Transistors

To Compete with Germanium

The glamor gadget known as the transistor got another boost recently with the announcement by Du Pont of a process for manufacturing pure silicon.

Although the possibilities of silicon in the electronics field have not been fully evaluated, this element is of much interest because of its ability to withstand higher temperatures and to handle more power than other semiconductors.

Up to now, germanium has been used in transistors, but recent tests show that pure silicon will compete with it in some uses, and for many purposes silicon is the only material that will work. This is particularly true where temperatures of more than 170 F are involved; silicon seems to work up to at least 400 F. Another potentially important factor is that, whereas germanium is extremely rare, silicon is one of the most common elements.

It is believed that pure silicon may also prove important in rectifiers, where it would compete with selenium. The object would be smaller rectifiers with more capacity.

At present, the entire production of pure silicon is coming from a small pilot unit at the Newport, Del., plant of the Du Pont Pigments Dept. The current price tag is $430 a pound. In this form it is a brittle, gray, sparkling element with crystalline appearance. Its specific gravity is 2.4 which makes it a little lighter than aluminum.

News Digest

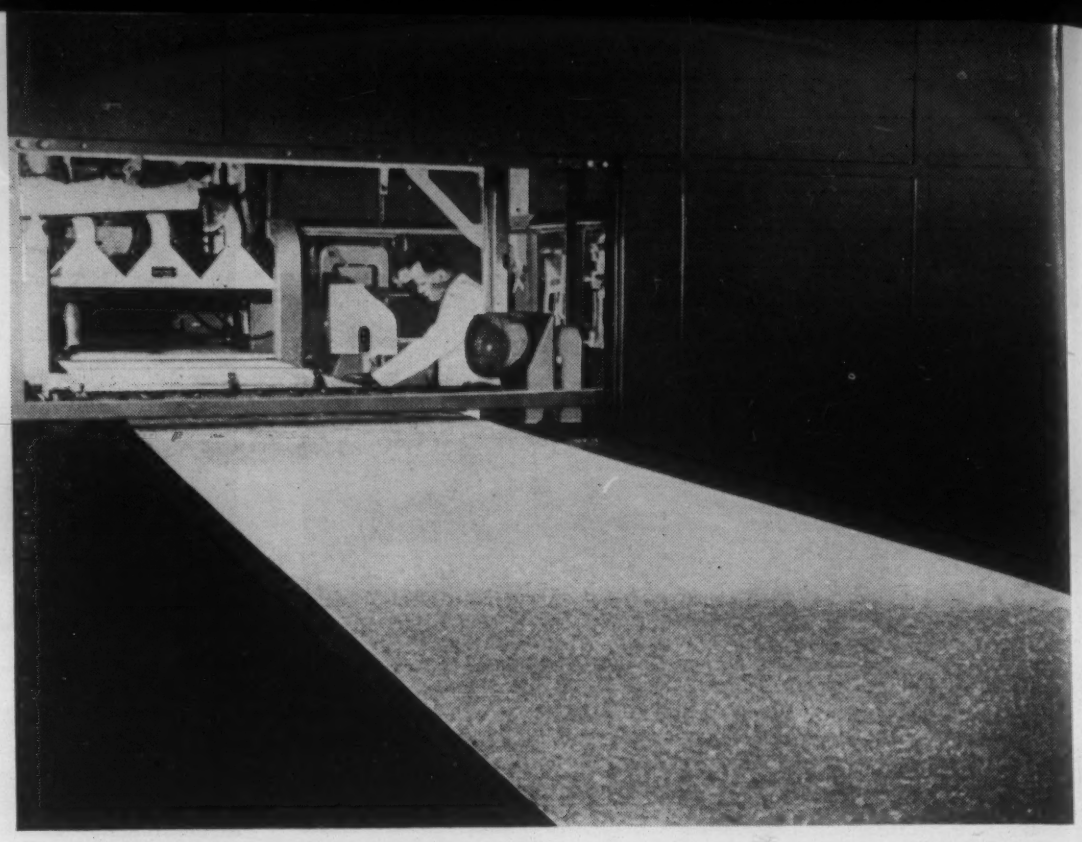
Platinum Pen Tip Electropolished

What is claimed to be the first successful electropolishing of a platinum-base metal is now being used in production by the Parker Pen Co., Janesville, Wis.

The operation was adopted to produce a precisely rounded sphere tip on the company's fountain pen points. This tip is formed from a platinum-base metal pellet and must have a fine finish if the pen is to have smooth writing qualities.

According to Dr. Arthur W. Peterson, the firm's chief metallurgist, the operation has been tested thoroughly and is now part of the company's manufacturing processes. Details of the electrolytic bath were not announced. The process was developed by Robert Shuman, associate Parker metallurgist.

Previous hand methods of finishing the points used grinding abrasives, which sometimes left scratches that could not be removed by burnishing. Particularly difficult to reach during the old process was the tiny slit which runs down the center of every pen point. Minute flaws which produce friction and make a pen "scratch" sometimes remained near the slit in the pellet after the old process.



Continuous Board is made from wood and wood waste by the Bartrev Press recently introduced in this country. The machine is 131 ft long, weighs 200 tons and requires only three men to operate. The continuous panel shown here is coming off the press at 20 fpm.

Latest in Wood:

Continuous Panel— High Grade, Low Cost

The trend toward better wood utilization was underlined recently by the introduction in this country of the Bartrev Press. This new machine, already in operation in England, converts wood and wood wastes into high quality all-wood panels on a continuous basis.

The developer of the machine, Bartrev Limited, thinks the new press should have the same effect on the wood industry as the continuous production of glass, strip steel and aluminum had in their respective industries. According to William J. Fishbein, British industrialist who headed a 14-year research and development program on the press, "the Bartrev Press brings scientific quality control and straight-line mass production methods to the wood industry for the first time.

"Because of these two factors," he says, "the Press produces a high grade, low cost, continuous wood panel which will sell for three to nine cents a square foot at mill level." He thinks the new material will have a great effect on the price structure of materials like lumber, plywood and hard board.

The board produced by the press is said to be uniform and warp-resistant. It can be worked with ordinary wood-working tools. Metal foils and laminates can be bonded directly to the board during the manufactur-

(Continued on page 148)

What They Said . . . . . .

PLASTICS MOLDINGS "Today, due to the larger equipment being employed, we can mold thermosetting parts up to 60 lb, with a draw of 24 in. and an area of 24 by 48 in."—*A. N. Williams, general sales manager, Plastics Div., General American Transportation Corp., Apr. 15, 1953.*

RESOURCES "There is a rather widespread recent tendency to conclude that we are on the way to become a 'have-not' nation. Curiously enough, this conclusion has been accepted chiefly by the economists. It is not accepted in large part by those who should be in the best position to appraise the situation—mining geologists."—*Thomas Nolan, Asst. Director, U. S. Geological Survey, Apr. 10, 1953.*

ALUMINUM CONSUMPTION "When this country last attained a similar level of aluminum production, during the war year 1943, about 80% of it went into military aircraft. Now the military share of the total runs to 25 or 30% and of that probably no more than half goes into military aircraft. The other 70% is being fanned out to almost the whole range of civilian industry . . ." —*R. S. Reynolds, Jr., President, Reynolds Metals Co., May 1953.*

Big Squeeze A 14,000-ton extrusion press, claimed to be the largest ever erected in this country, is now installed at Alcoa's Lafayette, Ind. plant. Also being installed is a huge "stretcher", four times as powerful as any in use, which is used to relieve the strains in the extruded aluminum parts.

Loose Joints A flexible joint for the fuel lines connected to jet wing tanks has been developed to minimize shock damage and resultant fuel leaks caused by air pockets.

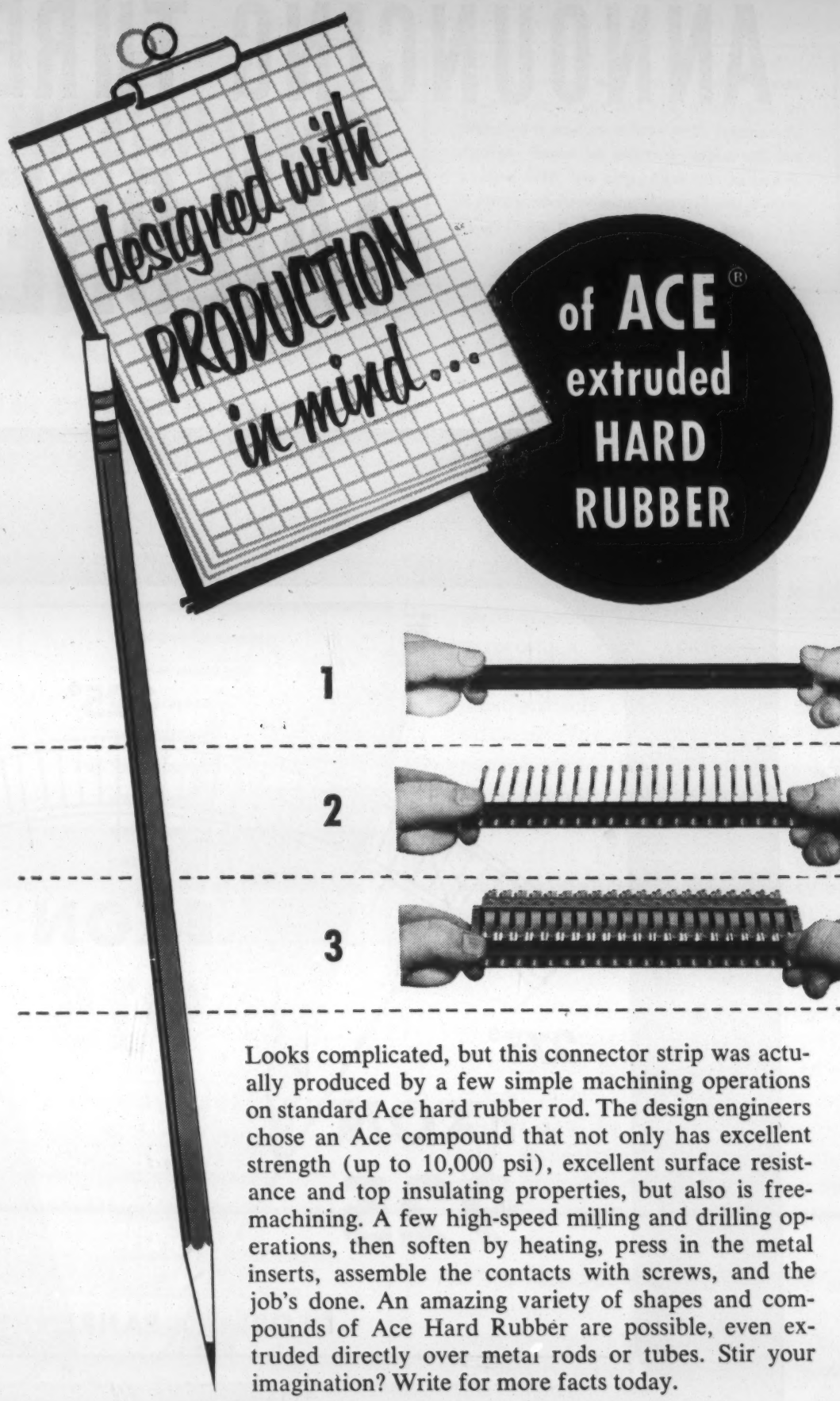
Stranded Electrodes Electrode wire is now being made by stranding together separate ductile constituent wires which, when deposited, produce homogeneous deposits of desired properties. The technique was developed for depositing certain compositions of weld metal, such as aluminum bronze and lead-tin bearing bronze, which have good properties but cannot easily be drawn into continuous homogeneous wire for the inert-gas shielded consumable-electrode arc welding process.

Substitute Stabilizer Suitable chromium and titanium additions to 18:8 chromium-nickel weld metal are a satisfactory substitute for the usual columbium addition, it has been found. Corrosion resistance comparable to type 347 and 308L electrodes was obtained with a chromium level of 22%.

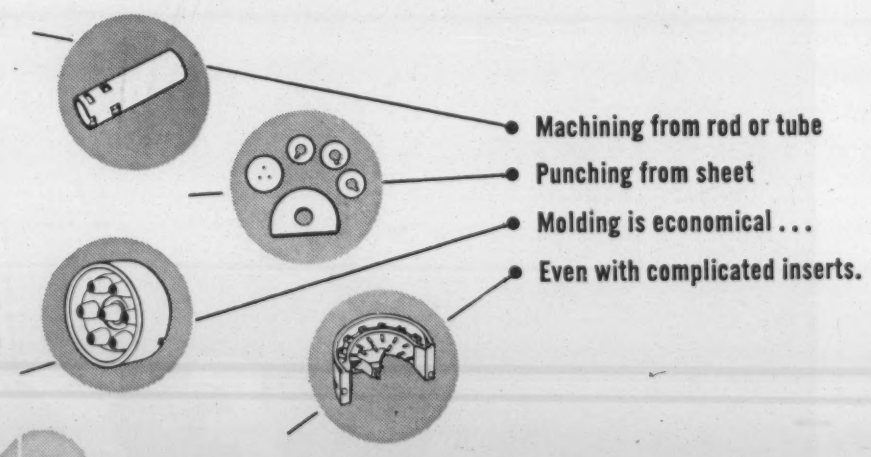
Rubber About two-thirds of the rubber used in the United States in 1952 was synthetic, according to one rubber executive.

Plastic Bubbles Infinitesimal hollow plastic spheres are being used to cut evaporation losses of stored petroleum. The "Microballoons" measuring 0.0001 to 0.003 in. dia., float on the top of the oil, forming a foamy cushion that lowers the effective vapor pressure.

All-Al Tank The first mass-produced all-aluminum ground vehicle, unveiled recently, is an amphibious cargo carrier. Its light metal construction makes it easily airborne, and the Army intends to use it for non-armored, noncombat duty.



Looks complicated, but this connector strip was actually produced by a few simple machining operations on standard Ace hard rubber rod. The design engineers chose an Ace compound that not only has excellent strength (up to 10,000 psi), excellent surface resistance and top insulating properties, but also is free-machining. A few high-speed milling and drilling operations, then soften by heating, press in the metal inserts, assemble the contacts with screws, and the job's done. An amazing variety of shapes and compounds of Ace Hard Rubber are possible, even extruded directly over metal rods or tubes. Stir your imagination? Write for more facts today.

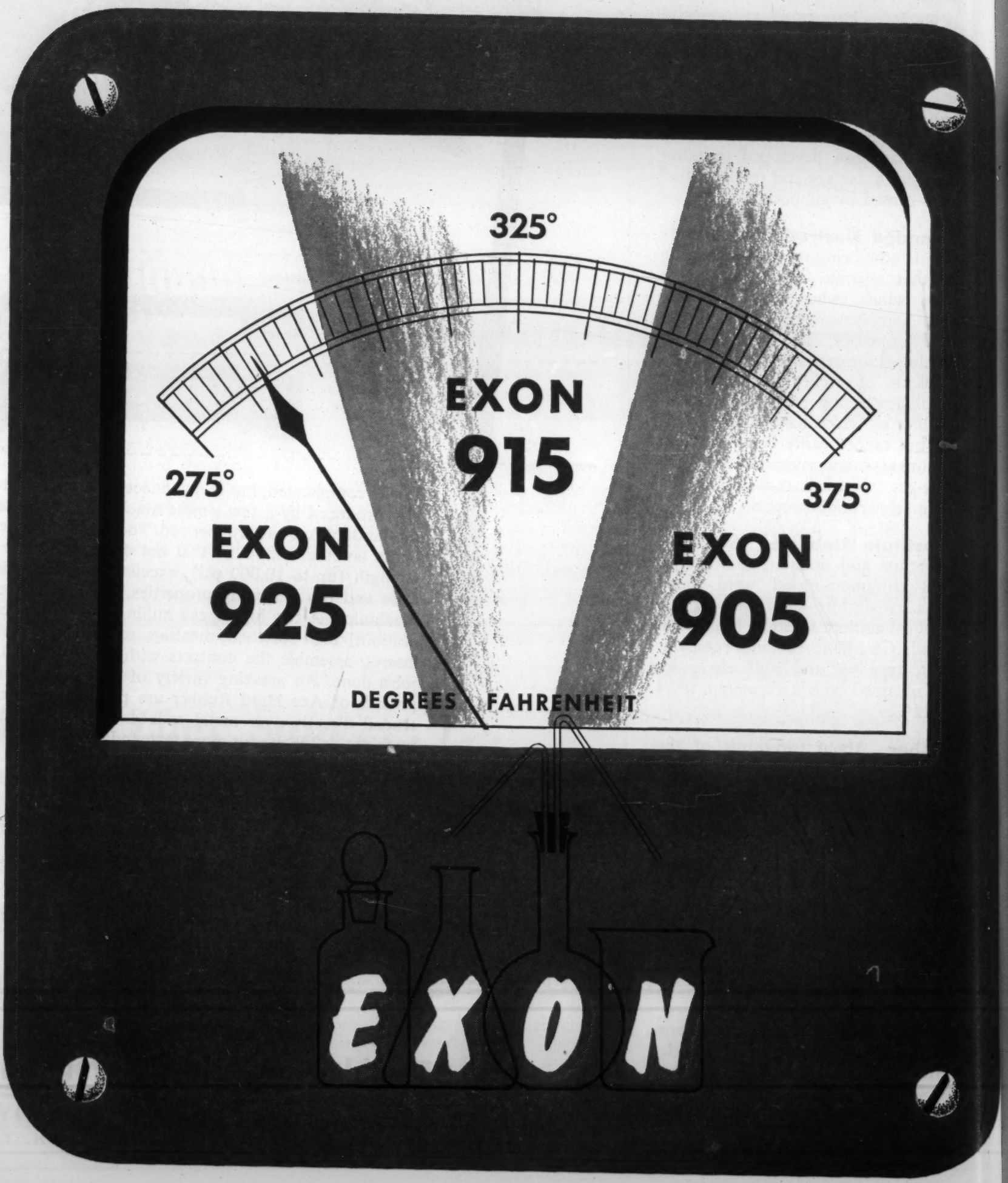


ACE rubber and plastic products

AMERICAN HARD RUBBER COMPANY
93 WORTH STREET • NEW YORK 13, N. Y.

ANNOUNCING THREE VERSATILE

TAILORED TO YOUR.....



DESIGNING WITH ALUMINUM

This is one of a series of information sheets which discuss the properties of aluminum and its alloys with relation to design. Extra or missing copies of the series will be supplied on request. Address: Advertising Department, Kaiser Aluminum & Chemical Sales, Inc., 1924 Broadway, Oakland 12, California.

NO. 2 THERMAL CONDUCTIVITY, REFLECTIVITY

CONSIDER USE OF ALUMINUM ALLOYS WHERE HEAT CONDUCTION OR RADIANT HEAT REFLECTION IS REQUIRED

At first glance it may appear to be a paradox that aluminum is both a good thermal conductor and a good reflector of radiant heat, but two separate phenomena and properties are involved.

Conduction is the process of heat transfer through a material by kinetic energy. Radiation is the transmission of energy from a source to a receiver through space by electromagnetic waves; those chiefly responsible for heat radiation are similar to but of no longer wave length than those for light. When absorbed, the radiant energy increases the temperature of the absorbing body.

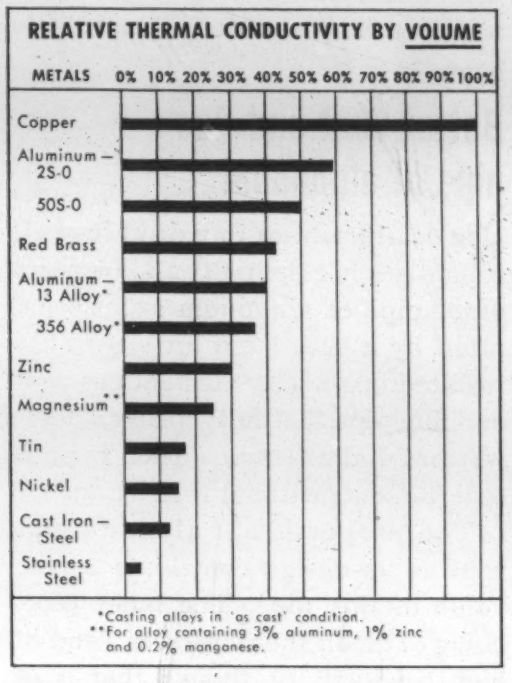
The possession of these two distinct properties—thermal conduction and radiant reflectivity—has proved of outstanding value in many successful applications of aluminum, especially as they are combined with such other properties of aluminum as corrosion resistance, light weight and strength, workability and economy.

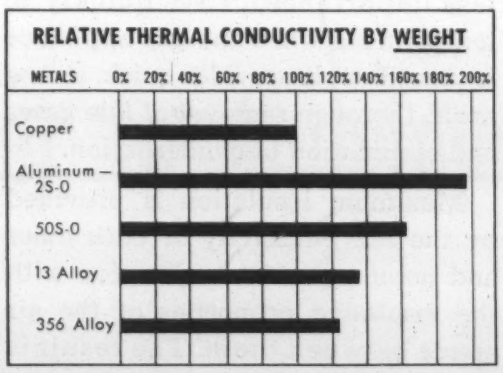
Aluminum best conductor on weight basis

Of the commercial metals aluminum ranks second only to copper in thermal conductivity on a volume basis. On a *weight* basis, however, aluminum has the highest thermal conductivity, with various aluminum alloys being superior to copper by a wide margin.

The relationship between some aluminum alloys and other metals with respect to thermal conductivity, as illustrated in the charts in the next column, shows why aluminum is worth considering where it is necessary to conduct or dissipate heat.

Localized "hot spots" resulting from use of a metal of inferior conductivity are troublesome and reduce efficiency, whether they occur in a cooking utensil or in a more complex application.





How aluminum's high thermal conductivity can greatly improve efficiency is demonstrated by its use in internal combustion engines, where one of the major problems is high temperature in the engine envelope. By dissipating heat rapidly, aluminum cylinder heads reduce temperature in the combustion chamber by as much as 100° F., thereby making it possible to obtain higher compression ratios by preventing detonation caused by a "hot spot." It has been found also that aluminum cylinder liners surfaced with hard plating have given a very considerable power increase over cast iron liners because of better heat dissipation.

More and more, the trend is toward greater utilization of aluminum to produce higher performance engines. In fact, power plants made almost entirely of aluminum are built not only for aircraft but also for marine application, tanks, trucks and such popular, work-saving products as power lawn mowers and portable chain saws. The light weight, corrosion resistance and workability of aluminum are beneficial as well in their design, manufacture and operation.

The thermal conductivity properties of aluminum also play a part in its use in torque converters (discussed in No. 1 of this information series, dealing with "Light Weight with Strength") by eliminating the need to make special provision for cooling to handle heat generated during operation.

An interesting specialized use of aluminum's conductivity, made practical because aluminum can be economically rolled to thin foil, is seen in cigarette-proof tables, desks and counter tops. A layer of foil just beneath the surface dissipates heat from the burning tip of a carelessly laid cigarette so rapidly that there is no scorching or burning.

Aluminum reflects short, long waves

Aluminum is highly reflective to both short wave (solar) and long wave radiant energy. Possession of this quality means also that aluminum is characterized by low absorption of solar heat and low emissivity, or radiation, of long waves.

PLEASE TURN TO NEXT PAGE ➡

In per cent, reflectivity plus absorption, or reflectivity plus emissivity, equals 100. Although polished aluminum surfaces such as bright aluminum foil have the highest reflectivity, up to 95% or 97%, even aged mill finish aluminum sheet retains this property to a marked degree.

The table below gives approximate values of these properties for aluminum in comparison to some other surfaces:

EMISSIVITY, ABSORPTION OF VARIOUS MATERIALS

	Long Wave Emissivity in %* (Radiation)				Solar Absorption in %* (Short Wave)	
	50-150°F		1000°F			
	New	Aged	New	Aged	New	Aged
Bright Aluminum Foil	3	5	5	10	5	15
Bright Aluminum Roofing Sheet	5	20	10	20	20	40
Mill Finish Aluminum Sheet	8	20	11	20	25	40
White Paint (Flat)	85	95	60	75	12	50
Colored Paint	85	95	..	..	65	88
Galvanized Iron	10	60	..	..	30	90
Black Non-Metallic Surfaces	87	98	..	..	85	98
Window Glass	90	95	..	..	Transparent**	
Wood	90	98	..	..	98	..
Steel Sheet	65	90	80	97	..	..

*Per cent reflectivity is 100% minus value listed.
**Actually reflects about 8% of sun's rays.

Reflectivity useful in varied ways

Inasmuch as radiant heat is frequently the major source of the total heat load, examination of these values shows why designers in various fields are making more use of aluminum to solve different problems.

It is obvious also how an aluminum roof makes a building cooler in summer—it reflects a high percentage of the solar heat, and only a small percentage of what is absorbed is reradiated by long-wave emissivity to the interior—and why aluminum foil makes excellent reflective insulation, whether new and bright or old and dusty.

Other ways in which the heat reflective property is being used with substantial benefit include reflective shields behind radiant heaters, radiant heat baffles in residential furnaces and radiant heat shields to protect workers who must tend high-temperature industrial furnaces.

Because of its low emissivity, a heating duct made of bare aluminum delivers more heat than other standard types of duct construction. Comprehensive tests (report available on request) between 12-inch diameter round ducts approximately 100 feet long showed that a duct made of new aluminum gave a temperature drop of only 43° F., as compared with a 61° drop for an asbestos paper covered galvanized duct.

It is possible, if so desired, to achieve directional radiation by painting or otherwise coating one side of aluminum and leaving the other side bare. When the metal is heated, the painted side will radiate heat but the bare side will emit little heat.

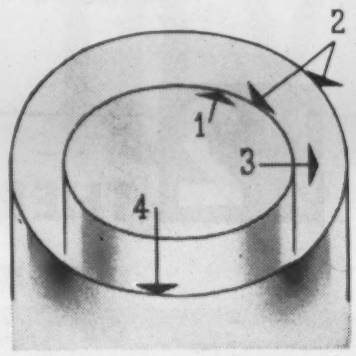
Better vent and flue pipe of aluminum

Use of aluminum in a double-wall construction, essentially an inner and outer pipe of aluminum sheet separated by a ventilated air space, has resulted in a highly efficient gas vent and flue pipe that fully meets Underwriters' Laboratories, Inc., Type B requirements without restriction.

The properties of aluminum as well as its design contribute to the value of this pipe. The inner pipe, being of small thermal mass (and of high conductivity, though that is of less importance), rises quickly to temperature when the gas appliance is turned on; it provides quick, strong draft, thorough removal of flue gases and elimination of condensation.

Maximum insulation is provided by the low emissivity of both inner and outer pipes in conjunction with the insulative properties of the air space between them. The result is that this type of pipe keeps adjacent wood surfaces from exceeding 90° F. above room temperature, the UL limit, even when flue gas temperature is at the American Gas Association-permitted maximum of 550° F. In other words, aluminum makes possible *a safer as well as a better operating construction* than other commonly used materials. Other advantages from the use of aluminum are light weight with easier installation, durability through freedom from cracking or breaking, resistance to corrosive influences, and economy.

HOW ALUMINUM VENT PIPE WORKS



1. Inner pipe heats rapidly.
2. Low emissivity of outside surfaces of both pipes provides minimum radiation.
3. Ventilated air space provides high insulation.
4. Inside surface of outer pipe reflects radiant heat.

Where heat flow occurs, investigate aluminum

If heat transmission or reflection is involved in a design and application problem, it will pay to investigate the use of aluminum alloys. Along with high conductivity or reflectivity, other aluminum properties will provide additional benefits.

Kaiser Aluminum engineers experienced in product design, development and fabrication will gladly assist you in getting the most from aluminum's unique combination of properties. Call or write any Kaiser Aluminum office, in principal cities. Kaiser Aluminum & Chemical Sales, Inc., Oakland 12, Calif.

Kaiser Aluminum

see our catalog in PRODUCT DESIGN FILE or write for copy

Setting the pace . . . in growth, quality and service

Surface defects in aluminum alloy castings can be repaired quickly by ultrasonic soldering.

by LEO WALTER,
Consulting Engineer (England)

Ultrasonics —The Answer to Aluminum Soldering?

Ultrasonic vibrations rapidly remove tough oxide film from aluminum surfaces. This results in improved tinning and better joint properties.

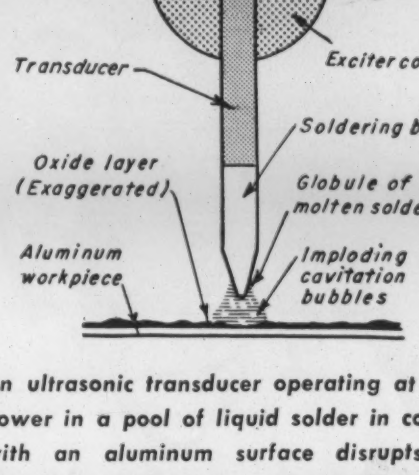
● ALTHOUGH fluxless soldering, making use of ultrasonic vibrations, is being applied commercially in England, it is relatively new to this country. In England the method has proved of greatest value for aluminum and its alloys.

Conventional soldering methods are not too suitable for aluminum because a tough oxide skin forms on the surface which is not removed by ordinary non-corrosive fluxes. Strong corrosive preparations can be used, but these possess obvious disadvantages. Reaction occurs not only with the oxide, but also with the base metal; and the danger of corrosion in a joint due to the inclusion of fluxing material is great, since these acids are active even at low temperatures.

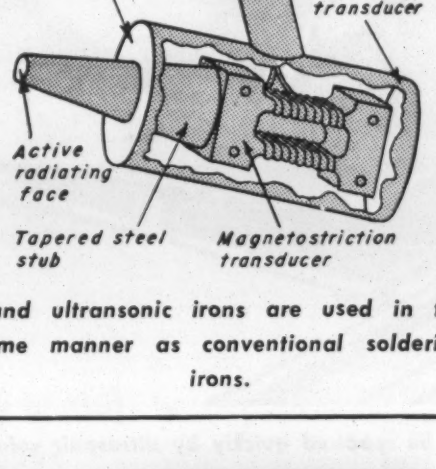
In the technique generally employed a special solder is used. This is melted on the aluminum and the surface beneath is scraped with a sharp tool or scratch brush. Thus, the oxide is removed mechanically while the solder serves as a cover to exclude air. As the clean metal surface is exposed, the solder can flow and alloy with it. Such a method, involving manual abrasion, can be applied successfully to aluminum sheet, but cannot be used for thin wire or foil or for very small pieces of metal that cannot be conveniently handled. It is not adaptable to the continuous tinning of strip or wire.

In coping with this problem of the satisfactory removal of surface oxidation, ultrasonic vibrations have proved valuable. By use of suitable equipment, ultrasonic vibrations are set up in the molten solder causing cavitation which serves to remove the oxide layer. Both a soldering iron and a tinning bath have been developed utilizing this principle.

In the case of the iron, the soldering bit is vibrated at an extremely high frequency supplied by an electronic generator. When the bit is covered with molten solder and applied to a surface, the erosion action occurs through the medium of the solder and



An ultrasonic transducer operating at high power in a pool of liquid solder in contact with an aluminum surface disrupts the aluminum oxide layer and permits tinning of the aluminum.



Hand ultransonic irons are used in the same manner as conventional soldering irons.

How Ultrasonics is Used for Soldering

Tinning and soldering by ultrasonic vibrations depends on the ability of the vibrations to set up cavitation in the molten solder rather than on the vibrations themselves. This cavitation is responsible for most of the well-known disruptive effects of high power ultrasonics. It occurs whenever a pressure wave of sufficient intensity is set up in any ordinary gassy liquid, including molten metals. If the amplitude of the pressure wave is allowed to exceed the static external pressure (normally one atmosphere), the many small bubbles normally present in suspension in the liquid are forced into violent radial motion. The bubbles expand rapidly as the liquid pressure becomes negative and collapse again during the positive cycle. The rapidly moving liquid in the immediate vicinity of the bubbles exerts enormous local pressure often capable of causing severe damage by cavitation to any solid surface on which the bubbles are occluded.

In hydraulic machines the enormous cavitation pressures often exceed the fatique strength of the metals used. For example, ships' propellers and turbine blades are slowly eaten away by the accumulation of small holes torn into them. Similarly, if an ultrasonic vibrator (or transducer) is made to operate at high power into a liquid in contact with a metal surface, this type of erosion may start both at the transducer face and on the metal. Therefore, care must be taken to choose a resistant material for the transducer or couple the vibrations from it to the liquid through another more resistant metal.

Ultrasonic cavitation sets in at lower intensities in molten metals than in other less dense liquids and, for a given ultrasonic power, the violence of cavitation and its erosive effects are greater. When a solid metal surface is covered with an unwanted film of impurity or oxide, this can sometimes be removed by exposing the surface of the metal to cavitating solder. The process becomes feasible without damaging the metal only if the film is less resistant to erosive action than the metal itself. This process of selective erosion can obviously be applied, not only to the easy soldering of "difficult" metals, but also in a more general way to the removal of solid impurities from the surface of any metal which is itself sufficiently corrosion-resistant.

Tinning an aluminum pattern preparatory to soldering.

erodes the surface; if the surface is of a metal that is capable of being tinned, the oxide on that surface will be abraded away, and a wetting action will occur. The tinning bath operates in the same way, the vibrations being applied to the botom of the bath and producing implosions throughout the molten solder. Articles dipped into the bath are thus subjected to the eroding action, and wetting or tinning results.

The ultrasonic method is more successful than manual abrasion since the oxide is removed from the whole of the metal surface in the active cavitating zone of the solder; whereas in the scratching method the effect is often merely to expose a number of scratched lines for "keying" the solder and the whole surface may not be covered. The cloud of cavitation bubbles in front of the vibrator scatters the ultrasonic beam, attenuating it seriously, and the active zone is normally confined to the immediate vicinity of the vibrator. This means that in tinning a large area of metal, it is necessary to move the vibrator over the entire surface, always with a molten solder band, but it is never necessary to actually touch the surface as with the scratch brush. The nuclei necessary for cavitation will always be numerous at the phase boundary between the liquid solder and metal where they come out of solution as occluded bubbles. Measurements show that erosion of the oxide over the whole area in the active zone actually occurs extremely rapidly. Under typical conditions, effective tinning can be obtained in less than 1/20 sec if the surface is first allowed to reach an appropriate temperature.

Ultrasonic Equipment

It is comparatively simple to generate mechanical vibrations of a suitable frequency and at sufficient power to produce intense cavitation in molten solder. There is a choice of several types of generator but from the very earliest experience, magnetostrictors have always been preferred for these soldering applications. There are, of course, very good reasons for this choice. Not only are these vibrators easily constructed to operate at suitable frequencies, but

they are the only type that can be made to vibrate really efficiently at the high temperatures required.

Magnetostrictors use the property, which ferromagnetic materials possess, of changing their physical dimensions when subjected to a changing magnetic field. The simplest practical vibrator of this type consists merely of a rod or tube of a suitable metal, such as nickel, which is excited electrically to vibrate at its natural mechanical resonant frequency. Intense vibrations can be obtained in this way, but such simple devices are inefficient if required to operate at high power.

The vibrators used in the more recent types of soldering devices, although similar in principle to these simple devices, differ considerably in their constructional details. For greater efficiency, a laminated structure is used having a closed magnetic circuit and wound with a toroidal coil. This carries a direct current for biasing purposes and an alternating current of suitable value at the correct frequency for resonent excitation of the stack. The transducer vibrates as a half-wave resonator with maximum movement at the two free ends and with a node at the centre.

In soldering applications, the essential requirement is a vibrator capable of producing violent cavitation in molten solder. Cavitation tends to increase in intensity as the operating frequency is reduced. Therefore, for economy, the aim must be to keep the frequency of the transducer as low as possible. The vibrators used in practice are kept just ultrasonic, at frequencies above the audible limit (16 kc/sec.) but generally below 25 kc/sec.

These general design features have been incorporated in practical ultrasonic soldering and tinning devices. The essentials of a modern commercial type of ultrasonic solderer intended to be used in the same manner as a conventional hand soldering iron are illustrated. Only about 50 watts of power at the appropriate frequency is needed for excitation and this is obtained from a small electronic drive unit.

The ultrasonic soldering equipment consists of two units, a soldering iron and a power unit. The soldering iron is supplied with a flat chisel bit for the treatment of large surfaces and a tapering bit for the treatment of cavities. The bit is heated by low voltage resistance winding of conventional type, the necessary power being supplied from a transformer in the power unit.

The bit is secured to a magnetostriction transducer, which converts the electrical energy from the power unit into mechanical vibratory energy, thus causing the tip of the bit to vibrate at a high frequency. The amplitude of vibration is very small, being in the region of fractions of a thousandth of an inch. A trigger switch in the handle of the iron controls the supply of ultrasonic power to the bit. The heater element is controlled from the main switch on the power unit.

An instrument of this sort is useful for tinning ordinary pieces of metal but cannot be conveniently applied to thin wires, foil, or very small articles. However, by substituting a small solder container of suitable size and mass in place of the tip, small and fragile articles can be tinned by a simple dipping process.

Applications

The introduction of the Mullard ultrasonic soldering equipment provided, for the first time, an effective and efficient method for soldering aluminum and other light metals without the use of flux. Today, this equipment is finding an increasing number of important commercial applications, and is helping to expand the scope and economic use of aluminum and its alloys in many branches of industry. One particularly interesting field of application is in the foundry where this equipment is proving valuable for the surface treatment of faulty light-alloy castings and for the modification and repair of aluminum patterns.

The main causes for the rejection of light-alloy castings in foundries are blow-holes, dross inclusions, and cracks. If these defects are severe, the faulty castings are scrapped and the cause of the trouble is diagnosed and rectified. In practice, however, some light-alloy castings are rejected on account of surface blemishes, which, although not materially affecting the strength of the castings, nevertheless mar their appearance. The reclamation of such castings has for long been a pressing problem in the foundry.

In the past metallized glues or molten aluminum have been used to improve the surface appearance. The results, however, have never been entirely satisfactory and the repaired areas could often be detected even after painting. With the aid of the Mullard ultrasonic soldering iron, surface blow-holes and cracks can be quickly and permanently filled, and an excellent finish obtained.

The advantage of this new soldering technique lies in the strong and permanent bond obtained between the solder and the base metal. Moreover, tin-zinc solder is used which has a texture and color similar to that of aluminum. This means that after machining, the treated areas are almost indistinguishable from the surrounding areas of the casting.

The treatment of castings by the ultrasonic soldering method is quite simple. The casting is first preheated to the melting point of the solder. The cavity is then filled with molten solder and the bit of the soldering iron is applied. The erosive action of the vibrating bit removes the oxide film on the sides and bottom of the holes and rapid and effective tinning occurs. The bit is then withdrawn. If necessary, further solder can be added and allowed to solidify, after which the surface can be machined to the shape of the casting.

Although the ultrasonic soldering process is quite effective for the rectification of surface defects in castings, it cannot be considered for joining castings where the design is such that appreciable stresses occur across the repaired break, because the zinc-base solder is normally not as strong as the base metal. If, however, the part of the casting to be treated is used only for ornamentation, lap and butt joints can be used. These will withstand all normal usage.

Another promising application of the ultrasonic soldering technique is in the modification and repair of aluminum patterns. Because of their greater resistance to wear, many foundries use aluminum patterns in place of wood in spite of the fact that alterations to light metal patterns have presented serious difficulties. Some success has been obtained with the riveting and red lead method, but this tends to be costly and wasteful. Using the ultrasonic soldering iron, however, an initial tinning of the area to be modified or repaired can be effected on which solder can be built up and formed to shape. The saving in time over the fabrication of a new pattern is considerable and the resultant part will withstand all normal usage.

Soft soldering can also be utilized in the manufacture of the initial light metal pattern with a saving in machine shop capacity by eliminating drilling and tapping the various parts to be joined.

Simplified Ball Bearing Fabricated From S

by **E. W. BATTERSON**, Supervisor of Wheeled Goods Engineering, Reo Motors, Inc.

Where speeds are slow and loading light, high precision, finely finished bearings are often not needed. In such applications it's wise to try lower grade materials and combine production operations.

● In response to the need for a simplified ball bearing for such items as children's wagons and power lawn mowers, engineers of Reo Motors, Inc., designed a bearing which can be made from steel tubing on a single machine, and heat treated after fabrication and assembly in one additional operation. The balls are purchased, and the tubes are made of redrawn resistance welded and seamless drawn tubing. Finished bearings are assembled with a light press fit into the pieces in which they will serve.

Anti-friction bearings are generally precision items, using high grade materials and close-tolerance machining, and the finished piece is necessarily expensive. Cost is a limiting factor in the selection of bearings for many purposes. For service where speeds are slow and loading is light, a bearing made with less finely finished surfaces and with wider tolerances may be capable of completely satisfactory performance. The simplified bearing meets these requirements and can be produced at low cost.

Forming Steps

The new bearing is formed completely on a single machine, with several automatic steps in the operation. One size each of welded and seamless steel tubing in stock lengths is fed to the machine, along with the steel balls, and completed bearings, ready for heat treating, are discharged. The manufacturing unit resembles a two-spindle automatic screw machine. The tubing is SAE 1010 steel.

The machine carries the smaller tubing, which forms the inside shell of the bearing, in one spindle, and the larger in the other. The smaller tube is 11/16 in. outside dia, and approximately 9/16 in. inside dia. The larger tube has an outside diameter of 1 1/16 in. and an inside dia of about 1 in.

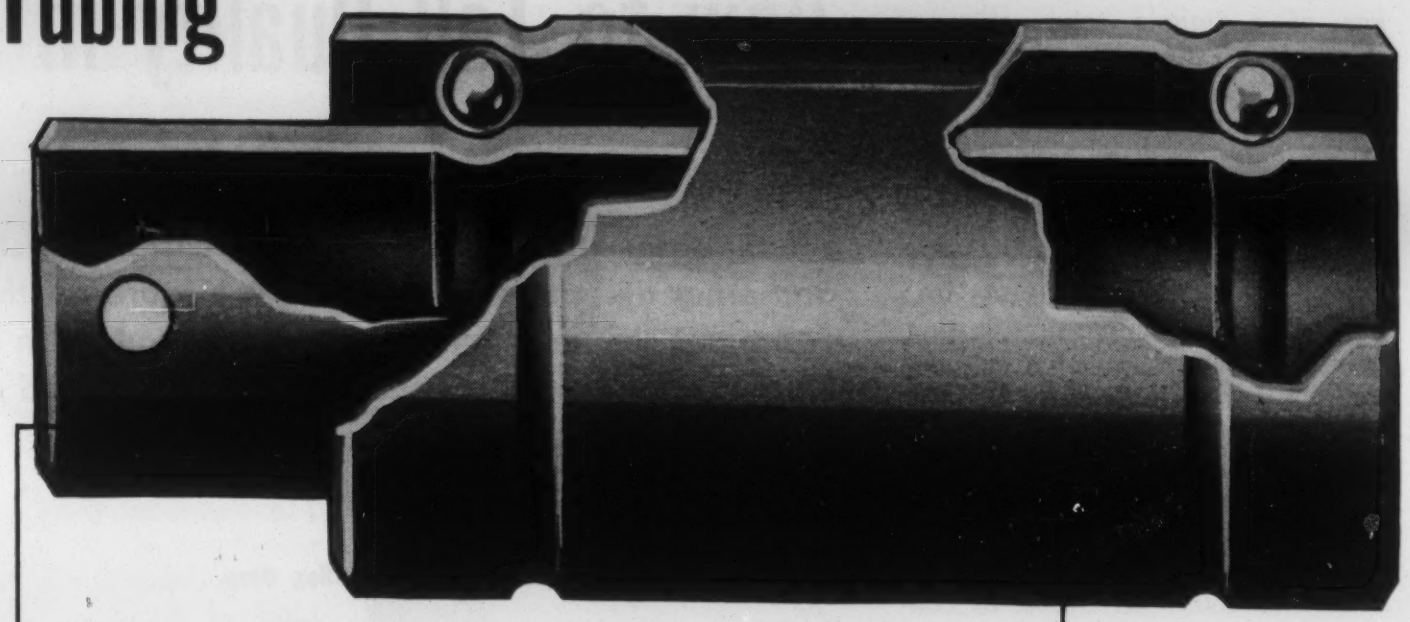
Processing starts with the smaller tube. This is extended from the chuck about 3 in. and firmly gripped. Two grooves are then rolled into its outer surface simultaneously to form the two inner ball races. A tubular tool next moves over the workpiece to the same position that the outer tube of the finished bearing will assume, and the balls are dropped automatically into the races through holes in this tool. The balls are held in position by the tool while the inner tube is cut to length. The tubular tool then moves the inner tube (about 2½ in. long) to the second machine spindle. The larger tube, held in this spindle, slides over the inner tube and the two sets of bearing balls, and replaces the tubular tool as it is withdrawn. Thus the balls are always held in the races. Grooves are then rolled into the outer tube to form ball retention internal rings, and the outer tube is cut off to a length of about 2 in. This completes the forming operations upon the bearing.

Heat Treatment

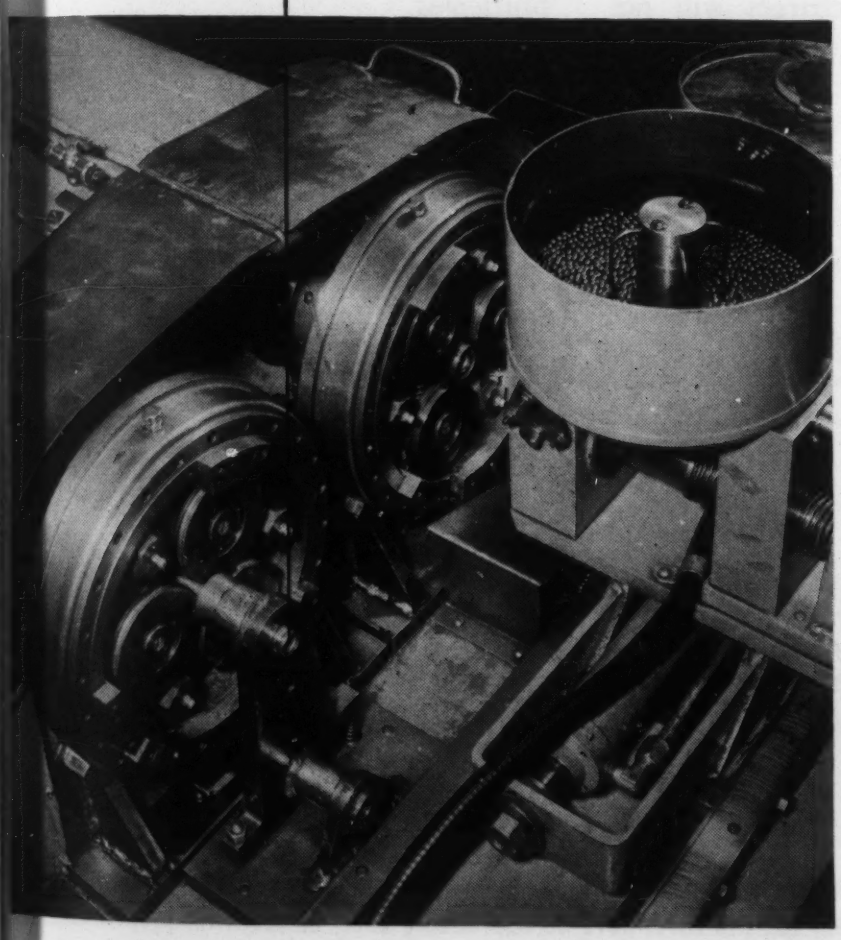
Heat treatment of the bearings is simple. They are placed on a special rack which holds them vertically. The bearings are then immersed in a carburizing salt bath for 30 min which forms a carburized zone of 0.006 to 0.008 in. depth. The bearings are then removed from the salt bath and quenched in a tank of water on which floats a 3 in. layer of oil. The floating layer of oil provides a cushioned quench, insures a brighter finish on all surfaces of the bearings, and deposits a protective oil film on the parts as they are withdrawn.

Tests with the bearings have shown excellent performance under the service conditions for which they are intended. The hardened bearings have more than adequate service life. Use of this bearing could be extended to applications in many sorts of appliances and equipment where low speeds and light loading are conditions of service. As the entire bearing is made of plain carbon steel, it does not involve any critical materials, or materials currently in short supply.

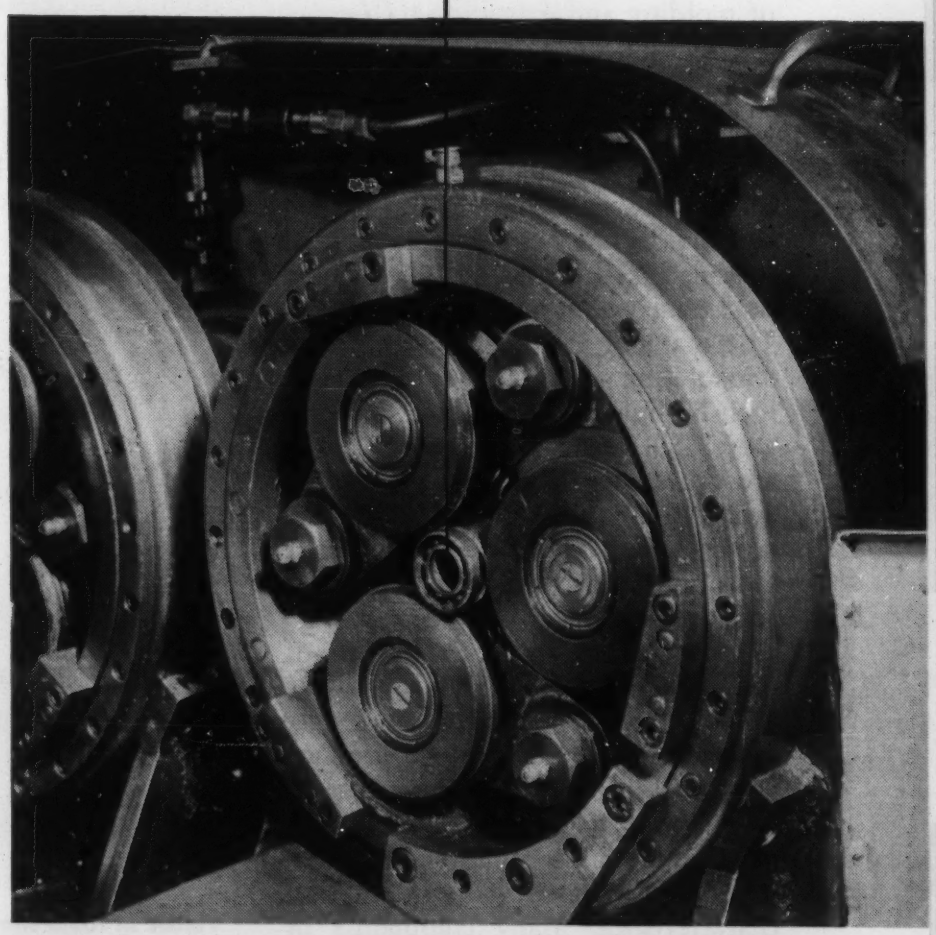
Steel Tubing



STOCK TUBING of two sizes and steel balls make up this simple, low-cost, anti-friction bearing.



INSIDE TUBE is grooved and cut to length.



OUTSIDE TUBE is placed over inner tube and steel balls, then grooved.

How to Tell Quality in Teflon

What causes spotting, porosity, dimensional instability and other defects in Teflon? . . . The source of these difficulties can be usually traced to the production of semi-finished shapes or the fabrication of fully finished parts.

by I. D. PRESS, Chief Engineer, Resistoflex Corp.

● DESPITE THE tremendous advantage of a unique combination of properties, Teflon has the growing pains of a new material. In the use of semi-finished shapes a number of misunderstandings have resulted because the effects of processing techniques were not fully appreciated. One potentially large user reported a 25% weight increase in a part after fluid immersion testing. In view of the chart value of 0.0% increase for Teflon, this was surprising. Another shop complained of spotting and discoloration. Other complaints have been hardness, softness, brittleness, waviness porosity, and dimensional instability. All these difficulties could be traced to conversion and fabrication.

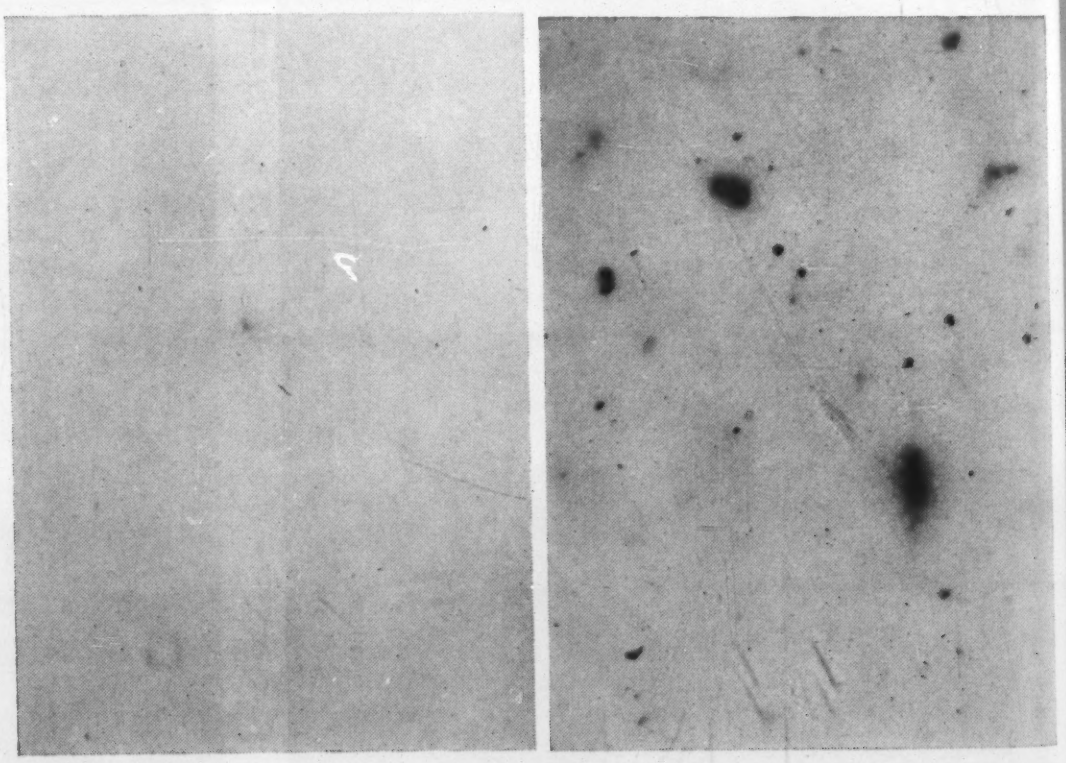
A property chart, listing values and test methods used, has been widely circulated by Du Pont, the sole supplier of the resin. The only way to evaluate a semi-finished Teflon shape or fully finished component is by comparison with these chart values. To apply them to actual products, however, an understanding of molding and extruding techniques and equipment is necessary.

How Shapes Are Produced

Teflon is shaped by methods similar to powder metallurgy and ceramic techniques. Although it is classified as a thermoplastic, it can not be melt-molded or melt-extruded. The material is compressed at room temperature into the desired shape, then brought up to sintering temperature. Sheets, short rods and tubes are made in simple molds and oven sintered. Continuous rods and tubes are extruded. This extrusion is really a continuous process of cold forming and oven sintering.

In molding, the introduction of the material to the mold and the pressure mainly determine quality and performance of finished product. If the resin powder is not evenly distributed in a sheet mold, high and low density areas will result. These will have varying physical characteristics. Many complaints of cold flow in gaskets made from sheet stock can be attributed to this cause.

Extrusion machines operating on ram and screw principles can be used. Ram extrusion, however, has largely replaced screw extrusion because of higher production and better control. While the ram method produces a better rod or tube, it introduces its own problems. The feed of material into the ram extruder is inherently intermittent. A continuing series of cold molded preforms are made in the extruder. To sinter into a homogenous mass these preforms must be cold compacted within very narrow pressure limits. Should the material be compacted too highly, successive charges will not fuse together. If the pressure is too low, a porous rod results. Extremely high compacting pressure gives brittleness at the interface, since individual compacts do not sinter together properly. Extremely low pressure results in a "rotten" type of brittleness.



A B

Values in table show that spots in sheet have no appreciable effect on electrical properties.

Effect of Spots in Teflon on Electrical Properties

	Dielectric Str, v per mil	Power Factor	Dielectric Constant
Clean White Sheet (A)	537	0.0003	1.97
Spotted Sheet (B)	531	0.0005	1.94

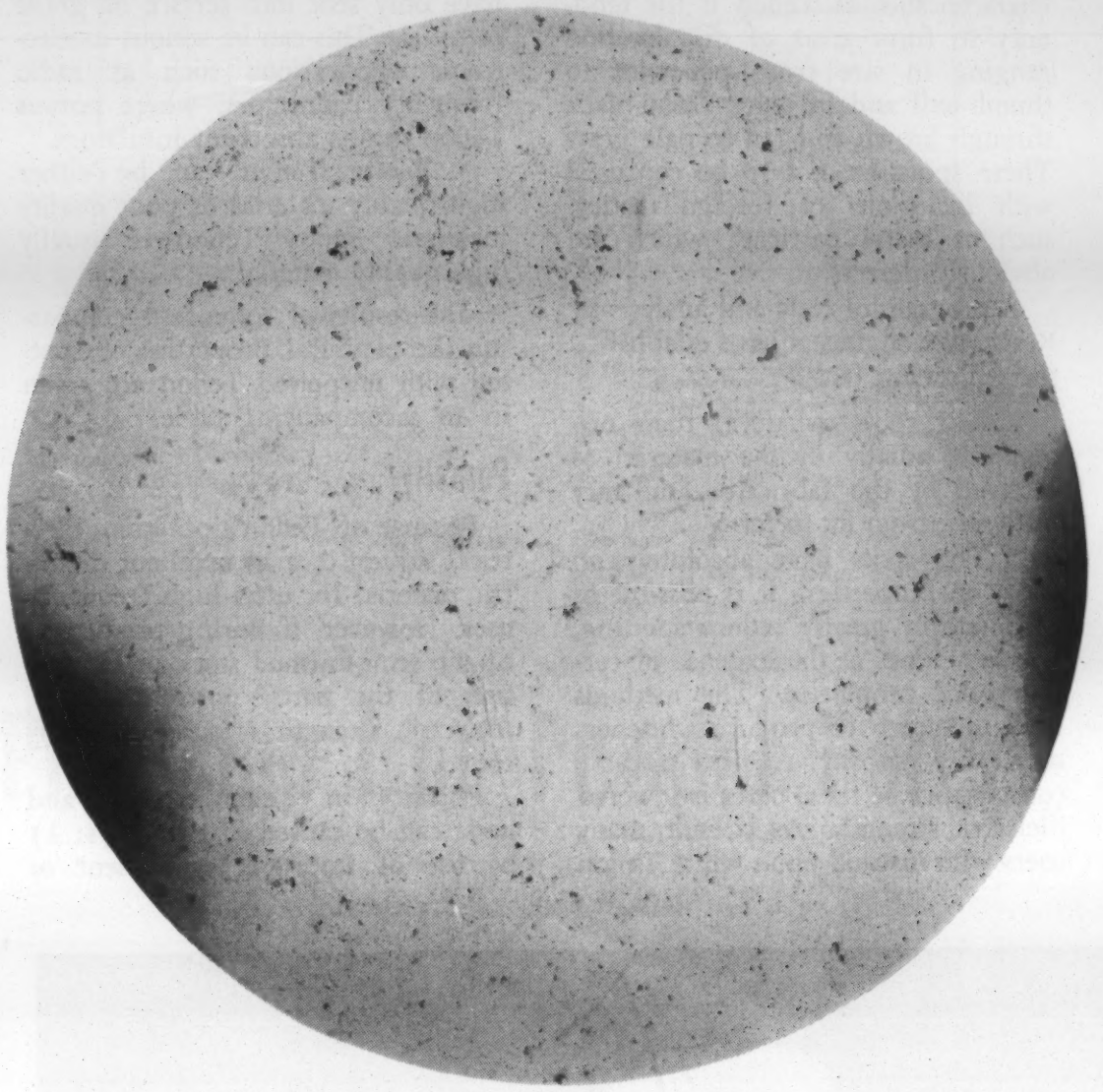
Fabricating Difficulties

Particle size and shape have a great effect on the density. Efforts of the Du Pont Co. to standardize and stabilize these resin characteristics have helped Teflon fabricators, but attention and instrumentation must still be devoted to the compacting operation.

Teflon has acquired the reputation of being unstable dimsensionally. It packs more readily than most powder materials. This tendency, combined with the difficulty of evenly distributing large volumes in a mold, often causes variations in a large molded piece. In machining large pieces from molded rod or tube, it may be difficult to hold dimensions by working to stops or settings on machine tools. Warping, growing, shrinking, are common complaints. Only recently have techniques been developed to give uniform density and stress relief throughout a large molded shape. As yet these techniques are confined to simple shapes.

The molding of multiple level pieces presents some problems. This is because of the poor lateral flow characteristics of Teflon. Some fabricators have made the mistake of attempting to mold Teflon in conventional plastics molds. Actually, pieces with more than one level along the axis of compaction should be produced on multiple ram presses. The high bulk factor of Teflon (4 and 5 to 1) dictates long stroke machines. Some of the few Teflon jobs produced on multiple ram presses have been made on what seemed to be ridiculously large presses. These machines were required for the fill and compacting stroke. It is safe to say that no standard multiple ram press exists today for the proper compaction of multiple level Teflon components. Compounding this difficulty is the fact that ejection of a Teflon compaction from the mold is often a problem. Because of these difficulties, those who use molded components should be alert to quality defects, particularly on parts for electrical and electronic fields.

Work is being done to overcome many of these difficulties by processes like coining, forming, drawing, hobbing and other postworking of sintered and semi-sintered Teflon. Results, which have been good in some cases and poor in others, are usually dictated by the shape of the part. Whenever possible, a user should consult with a fabricator before final design is frozen. This is particularly true with Teflon because it is not a low cost material.



Microporosity in a Teflon rod is revealed by dye penetrant test in this photo (X12 magnification). Table below shows how porosity effects dielectric properties.

Effect of Porosity on Dielectric Properties of Teflon

	Dielectric Str, v per mil	Power* Factor	Dielectric* Constant
	After 16 hr at 212 F (Dry Condition)		
No Porosity	592	0.0002	2.00
Moderate Porosity	254	0.0002	2.00
Porous	207	0.0003	2.00
	After 24 hr, 95% Rel Humidity at 77 F (Wet Condition)		
No Porosity	479	0.0002	2.00
Moderate Porosity	242	0.0003	2.00
Porous	154	0.0009	1.94

* *At one megacycle*

In many applications specified tolerances have tended to be unnecessarily severe. Although tight dimensions are necessary in some cases, consultation usually results in a widening of limits. Because of a vary high co-efficient of thermal expansion, the material should always be measured under standard temperature conditions. Measuring instrument pressures should be held to a minimum; whenever possible, optical methods should be employed.

Spots

One of the most discussed visual

characteristics of Teflon is the tendency to form areas of discoloration ranging in size from pin-point to thumb-nail and in color from black through brown and tan to pale gray. These spots are not to be confused with inclusions of foreign matter, such as metal particles, which are obviously defects.

A program of tests and analysis by Resistoflex engineers have established the following facts:

1. The spots, whatever their origin, are usually in the material as received by the fabricator and vary in degree from lot to lot.

2. The spots have absolutely no effect on properties. It is possible to eliminate or greatly reduce spotting, but sometimes at the expense of certain basic properties. The methods used to bleach or produce whiteness may cause porosity. Another possible consequence of these cures is lowered dielectric strength. As a result, many users who insisted upon white Teflon have only sent into service off-grade material. This can be serious in electronic applications such as radio frequency connectors, where porous Teflon means absorbent insulators.

3. White Teflon can be either high quality material or poor quality material. Spotty Teflon is usually high quality material.

The results of some tests comparing the electrical properties of spotted with unspotted Teflon are given in an accompanying table.

Porosity

Because of Teflon's optimum electrical values, it is an excellent dielectric material for ultra-high frequency uses. However, if during production of the semi-finished stock or fabrication of the parts, porosity results, dielectric strength is sure to be affected.

Porosity in Teflon shapes and parts can be caused in two ways: 1) by use of improper equipment or methods for compacting the powder into shapes; 2) by bleaching out the natural spotting at the expense of optimum density, as described earlier.

The accompanying table illustrates how the dielectric strength of Teflon is lowered, both under dry and wet conditions, by the presence of porosity. The table also indicates that although porosity has little or no effect on the dielectric constant, the power factor is increased under wet conditions. However, in actual service, porous parts are more susceptible to dirt which could cause serious changes in these two properties.

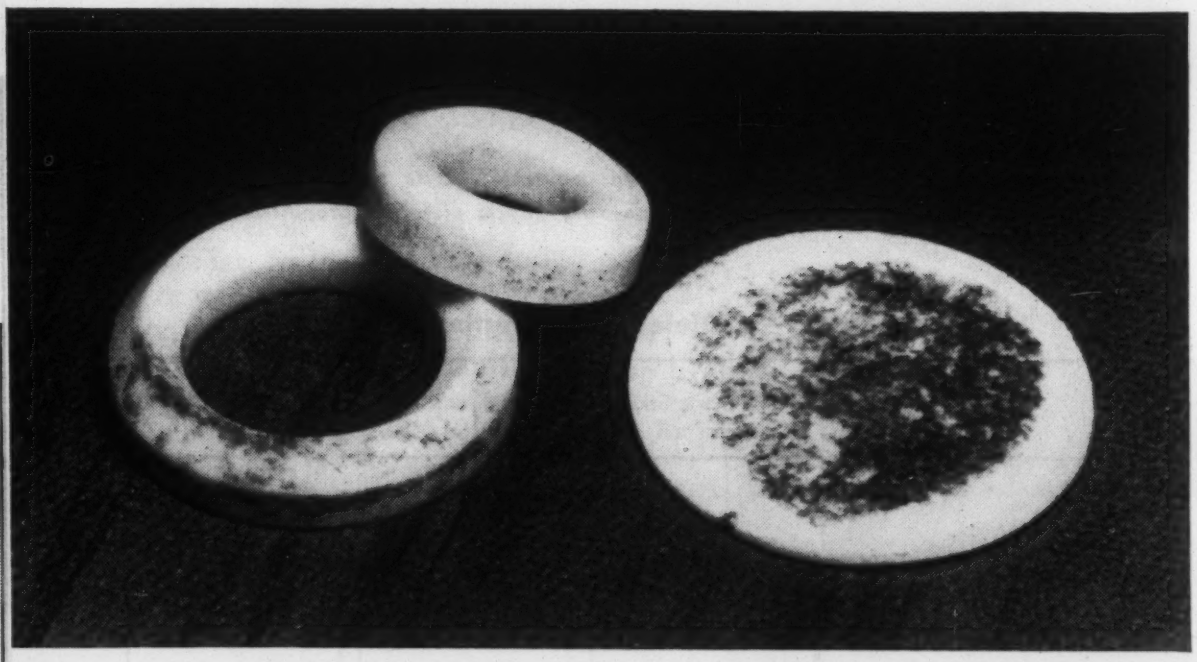
Tests

It is obvious that users cannot go through detailed laboratory tests to check out the properties of each lot of Teflon received. Visual inspection is valueless. Density tests do not correlate with tensile strength, porosity, dielectric factor, etc.

Customers can conduct two simple inspection operations, however. The first of these is the bend test. Properly schooled in what to look for, an inspector can bend a piece of Teflon rod or sheet material into a U shape around a mandrel and develop a great deal of information as to the structure of the stock. The sample to be tested may vary in length from 1 to 3 ft in length depending on the diameter. For rod diameters up to $\frac{5}{8}$ in., a mandrel with a diameter $1\frac{1}{2}$ times that of the sample should be used. For rods from $\frac{5}{8}$ to 1 in. dia, the mandrel should be 3 times the sample diameter. To perform the test, the sample is bent over the mandrel forming a U which conforms to the circumference of the mandrel.

Upon examining the surface of the rod at the periphery of the bend, sound Teflon will have a surface that is smooth, continuous, and show no apparent defects. Defective stock will show breaks or laterial cracks indicative of poorly bonded material or will show other kinds of fractures, fissures, and tears.

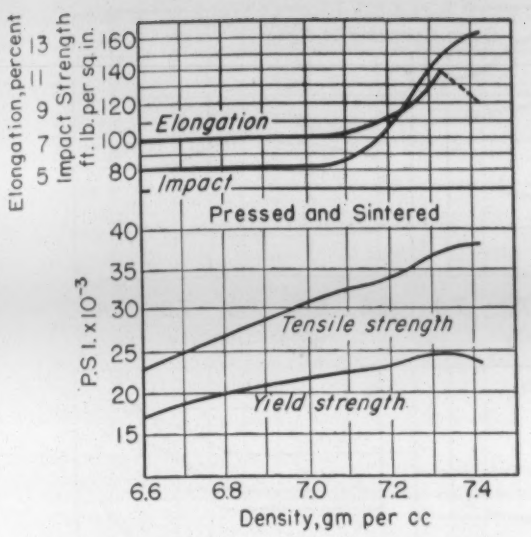
Another test is the penetrant dye check which very rapidly and positively tests for porosity, incipient cracks and other similar flaws. In this test, the penetrant is placed on the cleaned surface of the stock or part and allowed to stand for 5 min. After the excess is wiped off, the remaining visible spots of the red penetrant indicate porosity. Cracks in the material will normally show an irregular red line.



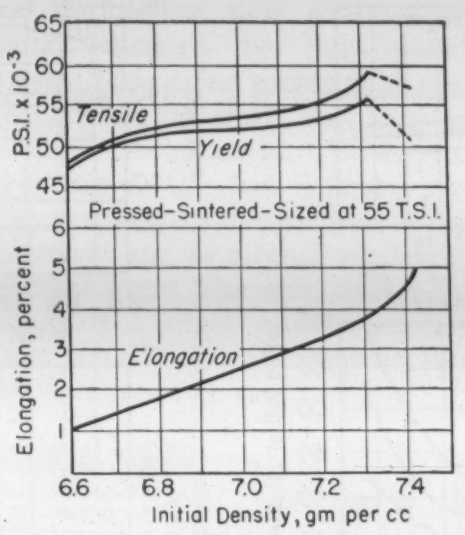
Teflon parts showing gross porosity revealed by dye penetrant.

This rod tested with a dye penetrant broke in bending and revealed porous structure.

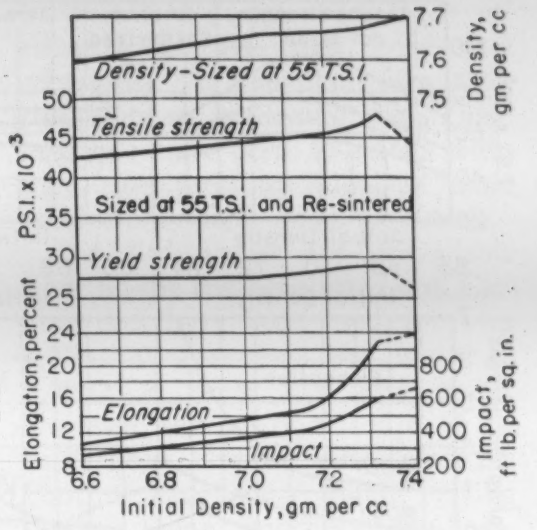
Bend test is a simple means of checking for defective Teflon stock.



Properties obtained after pressing iron powder to various densities and sintering at 2070 F.



Properties obtained on sizing parts having various initial densities at 55 Tsi.



Effects of sizing at 55 Tsi and resintering at 2070 F on properties of parts initially pressed to densities of 6.6 to 7.4 gm/cc.

High Strength Precision Iron Powder Parts—

- *Have Excellent Surface Finish*
- *Are Successfully Produced at High Production Rates*
- *Reduce Production and Tool Costs*
- *Have Low Scrap Loss*

by WILLIAM J. DOELKER and HAROLD T. HARRISON, The National Cash Register Co.

● AVAILABILITY OF soft electrolytic iron powder has made possible the production of high quality, high strength parts in large quantities with important reductions in both production and tool costs. Parts can be reproduced at high production rates, within very close dimensional tolerances. Some parts, produced by this method, are actually stronger than similar parts made previously from steel bar and strip. Surface finishes can be held, especially on the peripheral areas, to a microinch finish comparable to or better than ground surfaces. Tool costs, both initial and for maintenance, have been reduced to a point where it is profitable to produce even low usage parts by this method. Scrap losses have been held to a minimum and losses in the neighborhood of less than 0.5% are maintained at all times. These losses are not through dimensional tolerances but are due to breakage during handling in the green condition.

Powder

Of the number of salient factors involved in the production of high density parts, one of the most important is the type of powder. The following generalized characteristics must be present in any powder if it is to be used to produce strong, accurate, reproducible structural parts.

The powder must be of the highest purity and free from foreign material; the grain shape must be sharp or irregular; grain size distribution must be closely controlled; flow characteristics must be uniform; and hydrogen loss, which is an indication of oxygen content, must be low. Uniformity of powder from one lot to another is essential. To meet these requirements only certain grades of electrolytic iron powder are suitable.

The problem of powder cost is naturally of great importance. Electrolytic iron powder is more expensive than most of the other iron powders on the market and the cost

General Specifications for Electrolytic Iron Powder

Chemical Analysis, %
Total Iron: 99 min
Total Carbon: 0.04 max
Other Impurities: 0.1 max
Hydrogen Loss: 0.9 max

Grain Size
+100 Mesh: 4.2%
—325 Mesh: 30-40%

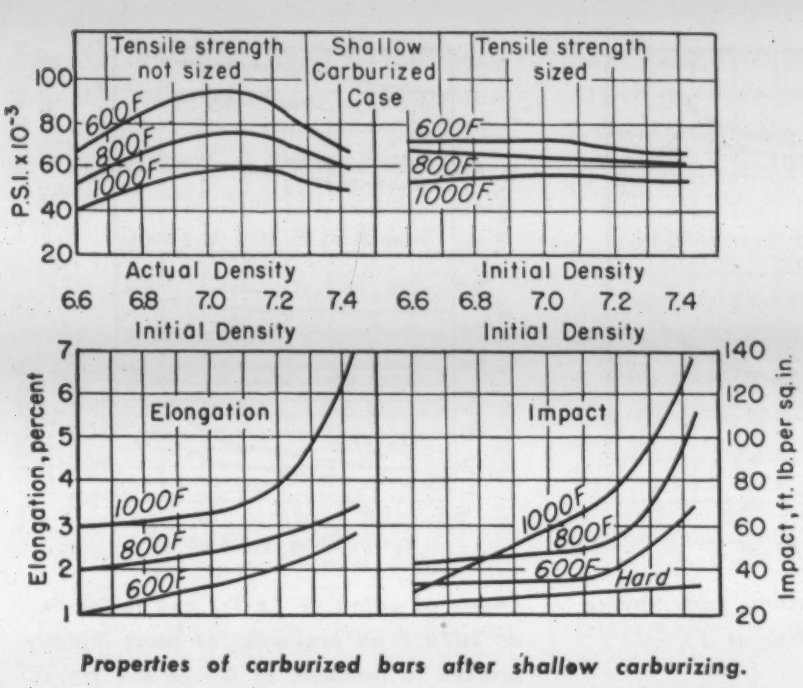
Flowability
34 ± 4 sec per 50 gm sample

Apparent Density
2.30 to 2.60 gm per cu cm

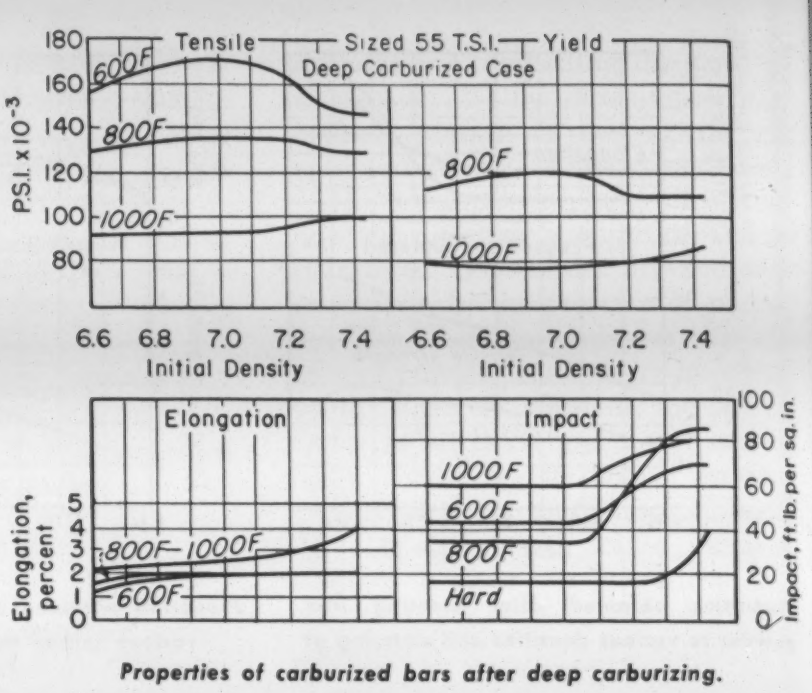
Green Density
6.50 gm per cu cm

Green Strength
Transverse Rupture Test
1600 psi min
Rattle Test 6% max weight loss

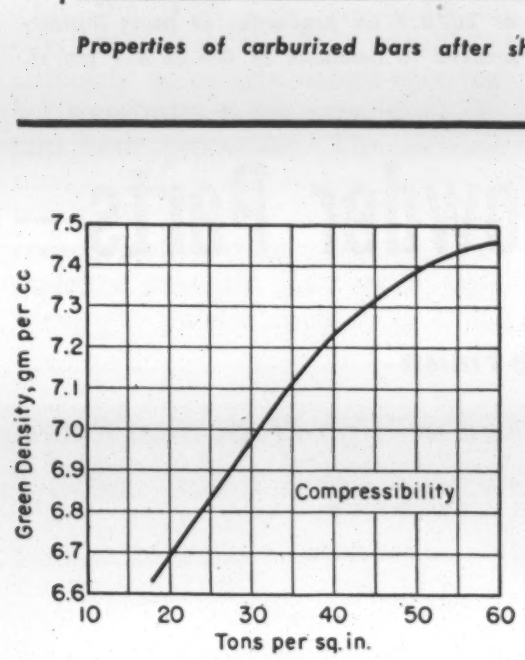
NOTES:
Test specimens pressed at 60,000 psi
Powder blend 1% Zinc Stearate
Pressing Pressure 60,000 psi



Properties of carburized bars after shallow carburizing.



Properties of carburized bars after deep carburizing.



Pressure required to produce various green densities after a single compacting operation.

of parts made of this material must be compared with those from which a part was originally made. It has been found, almost invariably, that the cost of electrolytic iron for producing a given part is on a par with the raw material cost for the same part made of steel bar or strip because no scrap is generated when iron powder is used, while a part cut or punched from steel bar or strip requires, normally, much more material than that which is used in the part itself. There are instances, however, where the material cost of the powder is a little higher, but this is offset by the reduction in production or tool costs.

Properties of Parts

The mechanical properties of parts produced from a given material are to a great extent, directly related to the density of the parts. These properties also depend, for a given density, upon the method used to attain that density and the condition of the part at the time. The carbon content and its method of introduction also affects the characteristics of the parts. The properties discussed are obtained by using a powder blend consisting of 99.5% electrolytic iron powder meeting the desired specifications and 0.5% zinc stearate which is added as a lubricant. This particular blend produces optimum conditions for obtaining high densities in relatively thin parts; i.e., parts in a range of thickness of 0.500 in. or less.

The final density of parts now in production lies primarily in the range between 7.2 and 7.7 gm per cu cm. This range encompasses the best combination of developed strength, ability to maintain dimensional tolerances, and ease of manufacture. The latter is based on press operation, die fill, surface finish, and tool life.

Electrolytic iron can develop relatively high densities under comparatively low compacting pressures. A graph indicates the pressure required to produce various green densities, after a single compacting operation. It requires only 18 tsi to produce a density of 6.5 gm per cc while 45 tsi produces a density of 7.3 gm per cc and 60 tsi a density of 7.45 gm per cc. At 53 tsi, however, a laminated structure starts to appear as a result of the relation between thickness, pressure, and lubricant. This pressure represents the critical pressure of briquetting for this particular powder blend and thickness.

Another graph indicates the properties that can be obtained when the powder is pressed directly to various densities and sintered at 2070 F for 45 min. The effect of lamination is indicated by changes in the slopes of the strength and elongation curves. Impact strength however, continues its upward trend due, in all probability, to the fact that laminated structures actually improve this property.

Properties obtainable by sizing parts, having various initial densities, at 55 tsi to produce a final density of 7.6 to 7.7 gm per cc are shown graphically. The advantages which can be obtained by pressing parts to high initial densities are apparent. Thus, a part pressed to an initial density of 6.6 gm per cc developes a tensile strength of 48,000 psi, a yield strength approximately the same, and a correspondingly low elongation of 1%; while a piece pressed to an initial density of 7.3 gm per cc developes a tensile strength of 58,500 psi, a yield strength of 51,000 psi and an elongation of 5%. The effects of laminating are again shown in parts having an initial density of 7.4 gm per cc as both tensile and yield strengths drop off sharply.

The effects of sizing, at a constant pressure of 55 tsi, upon the physical characteristics of parts initially pressed to densities of 6.6 to 7.4 gm per cc then resintered at 2070 F for 45 min are indicated in an accompanying graph. The final densities show relatively little variation, being in the range of 7.6 to 7.7 gm per cc. The tensile strength increases

with increasing original density. The effects of the laminated structure, which were not eliminated by the coining and resintering operation, are shown by a sharp decrease in tensile strength for bars having an original density of 7.4 gm per cc. Elongation and impact strength show the effects of coining from low and high initial densities. Elongation rises from 10% for bars having an original density of 6.6 gm per cc to 23%. Impact strength follows the same pattern.

The properties obtained when bars of various densities are given a light carburized case and when bars of various densities are sized at 55 tsi resintered and given a light carburized case are indicated in a series of graphs. Only bars hardened and tempered at 600, 800 and 1000 F for 1 hr are shown because facilities were not available for testing fully hardened bars.

Tolerances

One of the most important factors in determining the ability of powder metallurgy to replace conventional methods, aside from the strengths involved, is the dimensional tolerances which can be maintained on a production basis. It has been found that the higher the density of the parts, the closer the dimensional tolerances which can be held. The size of the parts, as in the case of all powder metal products, also influences the tolerances. Typical values are given in a table.

The dimensional changes that occur during the heat treatment of parts produced by this method present little or no problems as these changes are so small that they are almost inconsequential. This is probably due to the fact that the parts are completely annealed before heat treatment and as a result are free of internal stress. The only change that occurs is a slight growth resulting from the addition of carbon to form the heat treatable case.

Tolerances

Radial Dimensions[1]:	
±0.1% or ±0.001 in.	
Peripheral Dimensions or Radial Locations:	
±0.0005 in.	
Thickness[2]:	
Parts up to 0.100 in.[3]	±0.0015 in.
0.100 in. to 0.375 in.[4]	±0.001 in.
Over 0.375 in.[5]	±0.002 in.
Concentricity:	
0.001 in. (total indicator reading)	
Between Holes (hole sizes 3/16 in. or larger):	
±0.001 in.	

NOTES:

[1] *Exceptions on certain parts ±0.001 in. on 3 in. dia —0.0004 in. total on ½ in. dia*

[2] *Dimensions controlled by punch movement or powder fill. Where only a pressing operation is required.*

[3] *Somewhat closer tolerances are possible if coining is required.*

[4] *Only if parts are coined.*

[5] *About best obtainable even with coining.*

Surface Finish

Surface finish has greatly influenced the adoption of this process. Fnish is a function of die and punch surface and the use of carbide dies enables us to obtain exceptionally smooth surfaces which are not impaired through long usage and high pressing pressures. Surfaces obtained from punch presses using the finest of ground dies and multiple shaving operations cannot compare with those being obtained with this process. Screw machine parts have to be ground to approach the average finish of parts made in our powder metal department.

The average part which we produce has a surface finish, on those areas contacting the die, of 8 to 15 micro-ins. This finish will be maintained, or slightly improved, throughout the entire production life of the die. In certain instances, where it has been found desirable, the micro-inch finish is held to a 5 maximum and in one exceptional instance, parts having a finish of 0.8 micro-in. or less are obtained on a production basis. The surfaces in contact with the punches do not have a finish as fine as those contacting the die because they are not burnished during the ejection operation.

Tools

When parts are produced using high pressures in order to obtain higher densities, the type of tooling used becomes of increasing importance. Tool life is an important factor in any process and particularly so in the field of powdered metals as the inherent characteristics of the material being used is generally abrasive. A survey of available materials indicated that only carbides would be practical for dies.

The carbide dies are made in sections which are ground and polished, fitted, and held together with a heat treated steel bull ring. The type of carbide used depends upon the shape and usage of the part being produced. Punches are made of either a tungsten high speed steel containing 5% vanadium or a 12% chromium air hardening steel. These materials have been found to withstand the pressures involved more satisfactorily than other tool steels.

Die life figures are unavailable since no die has been worn out. Carbide dies have been used for over 9,000,000 operations and less than 0.0002 in. wear has been noted. However, sections of this type of die have been chipped and replaced. Punches have given widely varying results. Some punches have produced no more than 40,000 to 50,000 parts per grind and lasted less than 200,000 total operations; others have produced more than 100,000 parts per grind and lasted for a total of more than 2,000,000 operations. Core rod life varies greatly. Tool steel rods last from 50,000 to 200,000 operations, and carbide tipped rods or solid carbide rods last almost indefinitely from a wear standpoint. The biggest cause of loss incore rods is breakage.

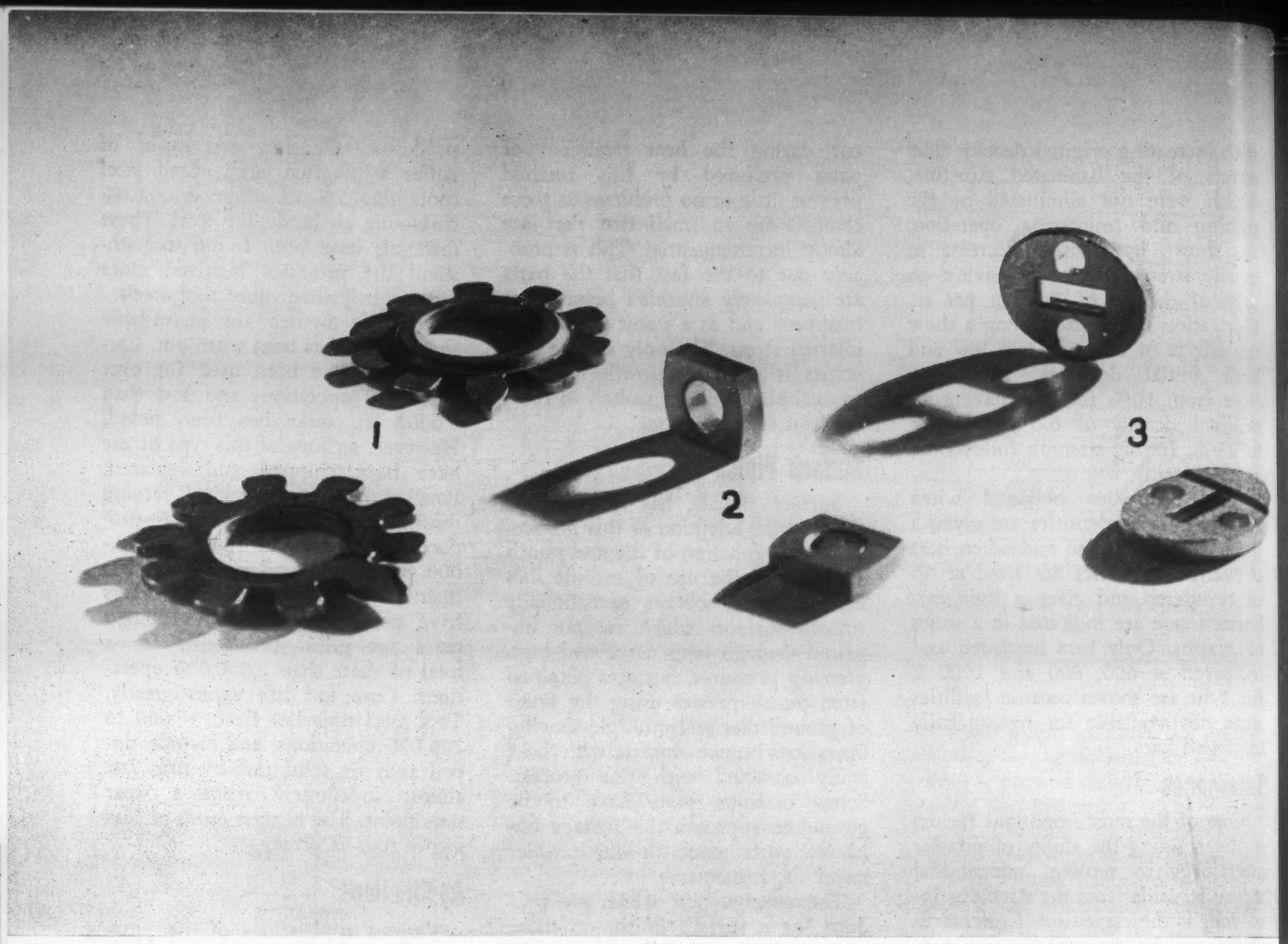
Applications

Various applications of the powdered metal process to our manufacturing procedure can be illustrated by a few specific examples.

One of the first items put into production is a counter pinion. This is an extremely hard working part. It must withstand high impact loads, operates at a very fast rate, and is one of the most critical parts in our product as it controls the addition and transfer in one of our most complicated machines. This part is considered to be the very heart of these machines and its failure would result in both an extensive and very expensive repair job. The part is carburized, hardened, tempered, and the tip of the long tooth locally rehardened.

As a result of these requirements a minimum over-all density of 7.4 gm per cu cm is specified. The major type of load applied to this part is impact, particularly on the long tooth. A comparison of the strength of these metal powder parts with those originally made from strip steel is interesting. Parts made from steel have an impact strength of 3.5 to 5 in.-lb. Those produced from electrolytic iron powder have an impact strength of from 12 to 16 in.-lb.

Since the production of these parts has been changed to powder metal-



Parts can be produced at high production rates to close dimensional tolerances. (1) Counter pinion, (2) link slide block, (3) key plate.

lurgy, over 4,000,000 parts have been produced to close dimensional tolerances. Actual scrap loss, resulting from parts broken in the green condition or improperly located in the coining die, has amounted to less than 0.5% in the total produced.

Production operations have been simplified also. The strip steel process requires a total of 28 operations while the metal powder process requires only 19 operations. In addition it has been possible to reduce inspection from 100% of each lot to a 10% or less spot inspection of each order. Numerous assembling problems have also been eliminated as well as an expensive tool upkeep program.

Another part is a special counter reset pawl. When this part was made from strip steel considerable difficulty was experienced in tool upkeep due to the relative thickness of the part in comparison to its size. In addition, the surface condition generated was poor and the dimension between the center of the hub and the projection used for resetting could not be maintained within close enough limits to obtain the correct alignment of the characters on the reading wheels without extensive adjustment.

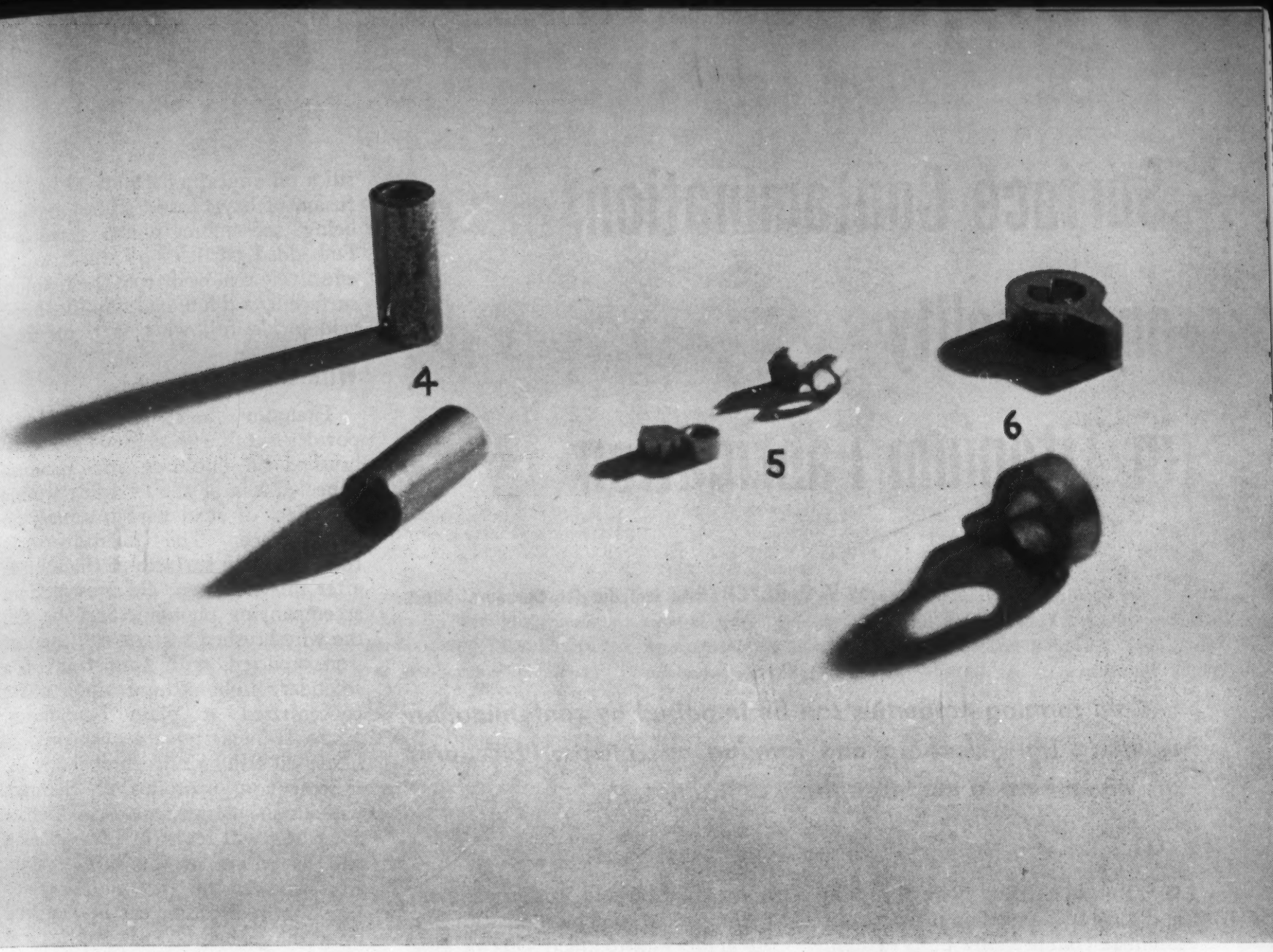
The dimension between the sharp corner of the resetting projection and the center of the hub is of prime importance. Since this corner drops off a sharp edge while the pawl is under spring tension it must be strong enough to withstand the impact. In order to obtain this strength a minimum density of 7.2 gm per cu cm is specified. The part is case hardened in cyanide to provide a wear resistant operating surface. More than 9,000,000 of these parts have been produced within the dimensional tolerances required. These parts are not coined but are pressed directly to the specified density and within the dimensional tolerances required with a single pressing operation.

Another part with which considerable difficulty was experienced when making it by conventional methods is a counter shifting link slide block.

This part was very difficult to manufacture as the dimensional tolerance between the straight edges is only $\pm$0.0005 in. The straight edges must be parallel and have a surface finish of 15 micro-in. or less over the entire surface. Under these conditions, conventional methods of manufacturing necessitated a grinding operation and even then difficulty was experienced in maintaining the dimensional tolerance and surface finish specified.

This part is heavily loaded as it must shift an entire counter assembly at a high rate of speed. It is very critical in its operation as it must properly locate the counter pinions and any wear or failure results in misalignment of these parts. As a result a minimum density of 7.4 gm per cu cm is specified. By using the powder metallurgy process, dimensional limits are maintained consistently and in addition they are produced with a surface finish of less than 12 micro-in.

The transmission shaft clutch is another part difficult to make due to its dimensional tolerances. The square hole has a tolerance of 0.1402 in. plus 0.0005 in. minus 0.0000 over its entire length of 0.625 in. In the previous method of manufacture this part was made in two sections. Each was milled with a 90 deg "V" cutter, they were copper



Surface finishes can be held to a microinch finish comparable to ground surfaces. (4) Transmission shaft clutch, (5) reset pawl, (6) add-subtract arm.

brazed and turned to size. The parts require sufficient strength to withstand deformation of the square hole to prevent misalignment in an internal drive mechanism which would result in wrong additions. The part has a large bearing surface over which the load applied can be distributed and the actual load is not exceptionally heavy. These parts are made to a minimum density of 7.0 gm per cm, which is one of the lowest density parts produced.

Due to the accuracy to which these parts had to be made it required the full time services of several men to meet production requirements when bar steel was used. Today the entire production requirements for a year are obtained in one week and a more accurate product results.

The key plate presents a different problem. In this instance, flatness is of prime importance. A plastic key tip is riveted to this part and it is desirable that this tip contact the plate over its entire surface, because these keys are used on a manually operated machine and considerable pressure is exerted on the key tip. Such tips are often loaded off center or eccentrically and if the key plate does not contact the entire surface of the plastic tip, very high loads are imparted to the small rivets holding it in place. These will then fail or loosen up and the plastic tip comes off the key.

Previous methods of production involve certain swaging operations which distort the key plate and prevent full support of the tip. Strength is of prime importance as considerable load can be imparted to the plate when it is loaded off center. The part, however, is relatively strong in itself. These parts are produced in a density range of 7.10 to 7.20 gm per cu cm.

Since changing this part to powdered metal we have had no failures due to the previously stated causes, and satisfactory operation has been assured.

The add and substract arm is a good example of a part designed specifically for taking advantage of the possibilities offered by the powdered metal process. This is a newly designed part and due to its shape, thickness, and dimensional tolerance could not be economically produced by any other method. It is a heavily loaded part and is being made to a minimum density of 7.4 gm per cu cm. Surface finish is 15 micro-in. or less and the location of the projection in the hub is held to a tolerance of plus 0.001 in. minus 0.000 in.

The little reset pawl would be extremely difficult and expensive to make by any other process due to its size, thickness, and shape. It could not be blanked out by a punch press as it is too thick for its size and, in addition, the working surfaces must be very smooth as it works with plastic counter wheels and a rough surface would cut into that material. It is too small to handle efficiently for most any other machining operation and special shaped raw material would be prohibitive because of price. Even if special shaped material were used additional machining operations would be required to obtain the finish required.

With the powdered metal process these parts are produced to a minimum density of 7.2 gm per cu cm with a single pressing operation at a rate of 7000 parts per hr and a surface finish of less than 10 micro-in. maintained over the entire periphery.

Adapted from a paper presented at the Ninth Annual Meeting of the Metal Powder Assn.

Surface Contamination and Quality in Titanium Fabrication

by V. C. PETERSEN, Metallurgist, Bureau of Mines

Cold forming properties can be impaired by contamination resulting from cleaning and forming operations. Procedures are given here to minimize these difficulties.

● SAND BLASTING, wire brushing and some special rolling practices contaminate commercially pure titanium to a measurable extent. Surface hardening by diffusion of such contaminants, which may be atmospheric gases, iron, or silica, causes a marked tendency towards transverse cracking in the first and second layers of grains during subsequent cold working. Lack of ductility in hardened surface layers is also reflected in poor cupping qualities of the resultant sheet. Thus, the surface characteristics of titanium as affected by fabricating processes must be considered if the finished product is to be of high quality.

Procedures are recommended in the following sections to prevent surface hardening, improve sheet-metal cupping qualities and minimize transverse cracking during cold working.

Sand Blasting

When titanium is sand-blasted, fine particles of silica are embedded in the metal surface. On subsequent heat treatment these react with and diffuse into the base metal. The character of the sand-blasted surface is influenced by shape and size of sand particles; the finer abrasive gives a finer matte finish, while a well rounded sand results in less silica pick-up than a crushed angular blasting sand.

The degree of surface contamination caused by cold working and annealing after sand blasting with No. 50 grade well-rounded Ottawa sand was determined on two samples of commercial-grade, arc-melted titanium plate by 1) sand-blasting on one side and vacuum-annealing 2 hr at 1650 F; and 2) sand-blasting on one side, cold-rolling 30% and vacuum-annealing 2 hr at 1650 F.

Vickers microhardness traverses, made with the Tukon machine on sections cut through the annealed plates, indicated a general hardening for a depth of 0.001 to 0.002 in. for sample 1, and 0.002 to 0.003 in. for sample 2. As a check on surface conditions, a microhardness traverse was made on a section of sample 2 near the surface that was not sand blasted. Hardness results given graphically show no essential hardness gradient in the surface layers, the hardness variations and distortion of hardness impressions being caused by grain orientation. Such variations are normal in an annealed hexagonal metal.

The sand-blasted surface of sample 2 was examined after annealing by x-ray diffraction methods and found to give Ti_5Si_3 (titanium silicide) and alpha titanium diffraction patterns. Spectrographic analysis of surface turnings 0.002 in. in depth when compared with core metal turnings showed a tenfold increase in silicon content.

The hardened skin is considered to be caused by a breakdown of silica on annealing, followed by diffusion of oxygen and silicon, oxygen being the more potent hardener. Embedded particles of silica can be effectively removed from the titanium surface by a dilute hydrofluoric, nitric acid pickle following sand blasting.

Wire Brushing

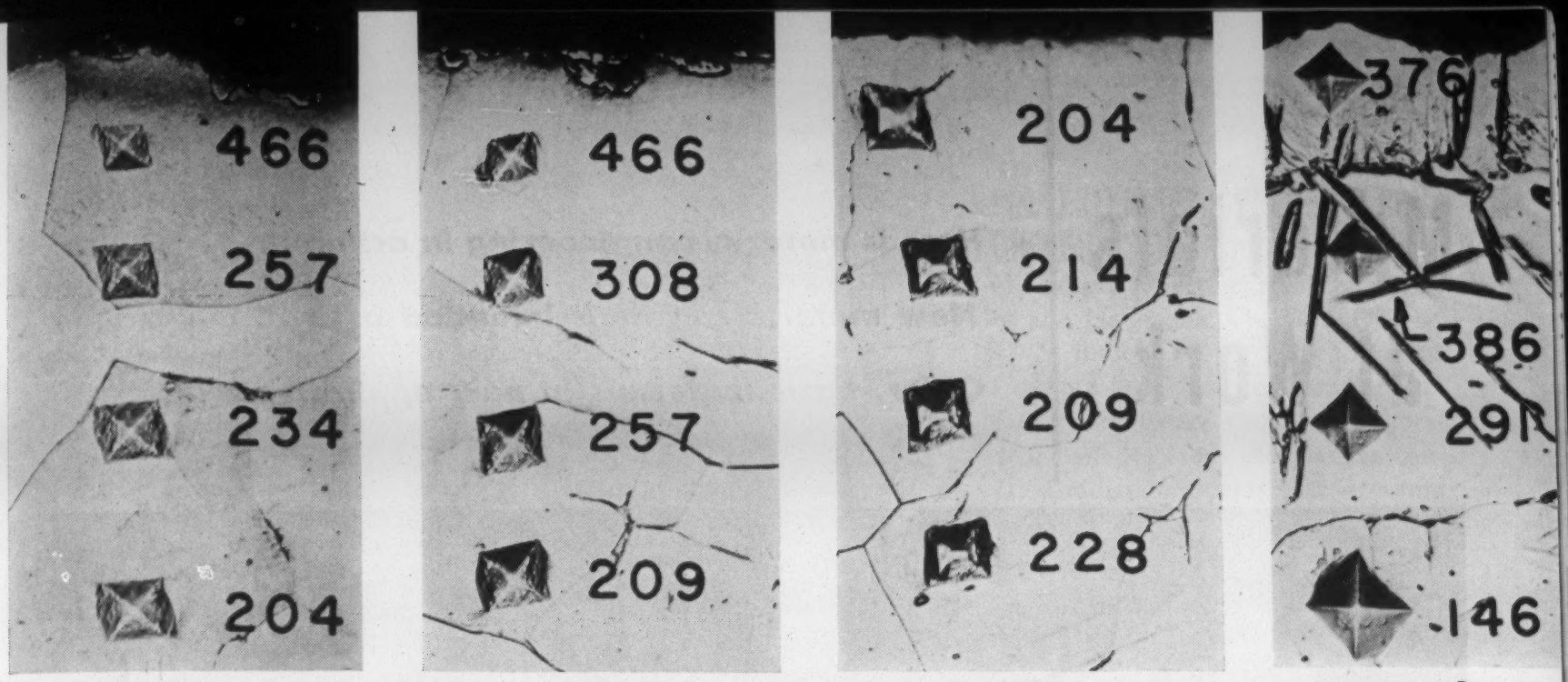
Titanium sheet consolidated by powder-metallurgy methods was wire-brushed on one side and vacuum-annealed 2 hr at 1380 F to determine the effect of steel wire brushing on the surface. The microstructures found on both surfaces of the sample after this treatment are presented in accompanying photomicrographs. On the wire-brushed surface, diffusion of iron occurred, with formation of a secondary light etching alpha phase concentrated at grain boundaries. Microhardness traverses showed a hardened skin to a depth of 0.001 in.

Steel wire brushing of titanium without an intermediate pickle before annealing will result in iron solution and hardening of the surface skin. Iron smeared on the titanium surface by wire brushing can be removed by a dilute hydrofluoric, nitric acid pickle.

Sheath Rolling

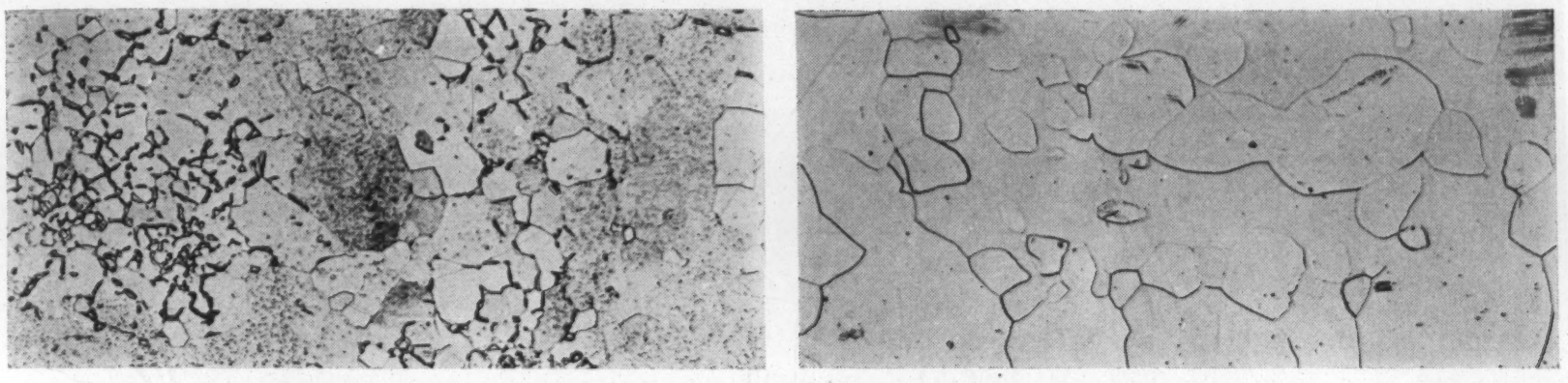
Sheath rolling of pressed titanium powder and sponge material is a means of simple consolidation into solid metal. In sheath rolling, a pressed titanium-powder compact is inserted into a close-fitting steel container and sealed by welding to exclude air. The assembly is then hot-rolled at temperatures up to 1740 F to the desired thickness. After cooling, the steel sheath is stripped from the titanium sheet. While there is no positive welding of the titanium sheet to the steel sheath under the conditions used, there is some diffusion between the iron and titanium. The extent of diffusion depends on time, temperature and degree of local contact between the titanium sheet and the steel sheath.

An accompanying figure shows a section through a titanium-sponge compact sheath rolled at 1740 F. Here, structure and a microhardness survey show iron contamination to an average depth of 0.004 in. This sample, when subsequently oil-quenched in a helium atmosphere from 1740 F, gave a surface diffraction pattern of retained beta titanium. From a calculated relationship between the beta-phase lattice parameters and percent iron composition,



A B C D

Vickers hardness numbers (50-gm load) near surface of titanium after various treatments. A—After sand-blasting and vacuum-annealing at 1650 F; average base-metal hardness 200 VHN/50 gm. B—After sand-blasting, cold rolling 30% and vacuum-annealing at 1650 F; average base-metal hardness 217 VHN/50 gm. C—Not sand-blasted; average base-metal hardness 217 VHN/50 gm. D—After sheath-rolling. Edge shown is the sheath-rolled surface. Average base-metal hardness 145 VHN/50 gm. (Magnification 500X).



Structure of surface of titanium sample after wire-brushing and annealing at 1380 F (left). Sample which had not been wire-brushed (right). (Keller's etch. Magnification 250X).

the iron content at the extreme surface was found to be about 6% as compared to a chemical analysis of 1.8% iron for surface millings cut to 0.003 in. depth and 0.1% iron for the original material. These results agree with previous work at this laboratory, which established an iron content in excess of 4 to 5% as necessary to retain beta on water quenching titanium.

Except in applications where a hard surface crust is desirable, sand-blasting the surface of sheath-rolled titanium stock and following with a dilute hydrofluoric-nitric acid pickle effectively rids the surface of iron contamination.

Cold Rolling

There is a definite tendency for titanium to seize and gall in applications involving sliding contact. The metal will flow when buffed, and smear when rubbed on a hard, smooth surface, such as glass. With a background of these characteristics, it was to be anticipated that under certain conditions some degree of surface contamination could be experienced in the cold rolling of titanium.

Corrugated rolls used in the cold reduction and consolidation of pressed and sintered titanium powder offer a greater kneading action than flat rolls. A small but measurable amount of iron pick-up occurs with corrugated iron rolls as shown by the wear of roll corrugations in service and a pick-up of a few tenths percent iron in the titanium sheet surface.

After consolidation to theoretical maximum density has been achieved, a pickling treatment is given followed by further reduction by hot or cold rolling using flat rolls. This intermediate pickling removes the iron contamination.

Several tests were made to check iron pick-up in the cold rolling of titanium when flat alloy steel rolls were used. Microhardness surveys gave no hardness increase in the surface layers and analyses made with a fluorescent x-ray spectograph showed no increase of iron in the surface over that of the base metal. Analyses were restricted to a surface layer of 0 to 0.001 in. with a sensitivity of $\pm 0.02\%$ for a titanium sample with a nominal iron content of 0.1%. The use of the Ferroxyl paper test for detecting iron on the surface of titanium sheet cold-rolled with flat alloy-steel rolls is inconclusive as an indication of iron pick-up due to the possibility of iron segregation in the base metal. Although the Ferroxyl paper test is a very delicate indicator for detecting iron, results are not sufficiently reproducible for quantitative work.

Hot Working

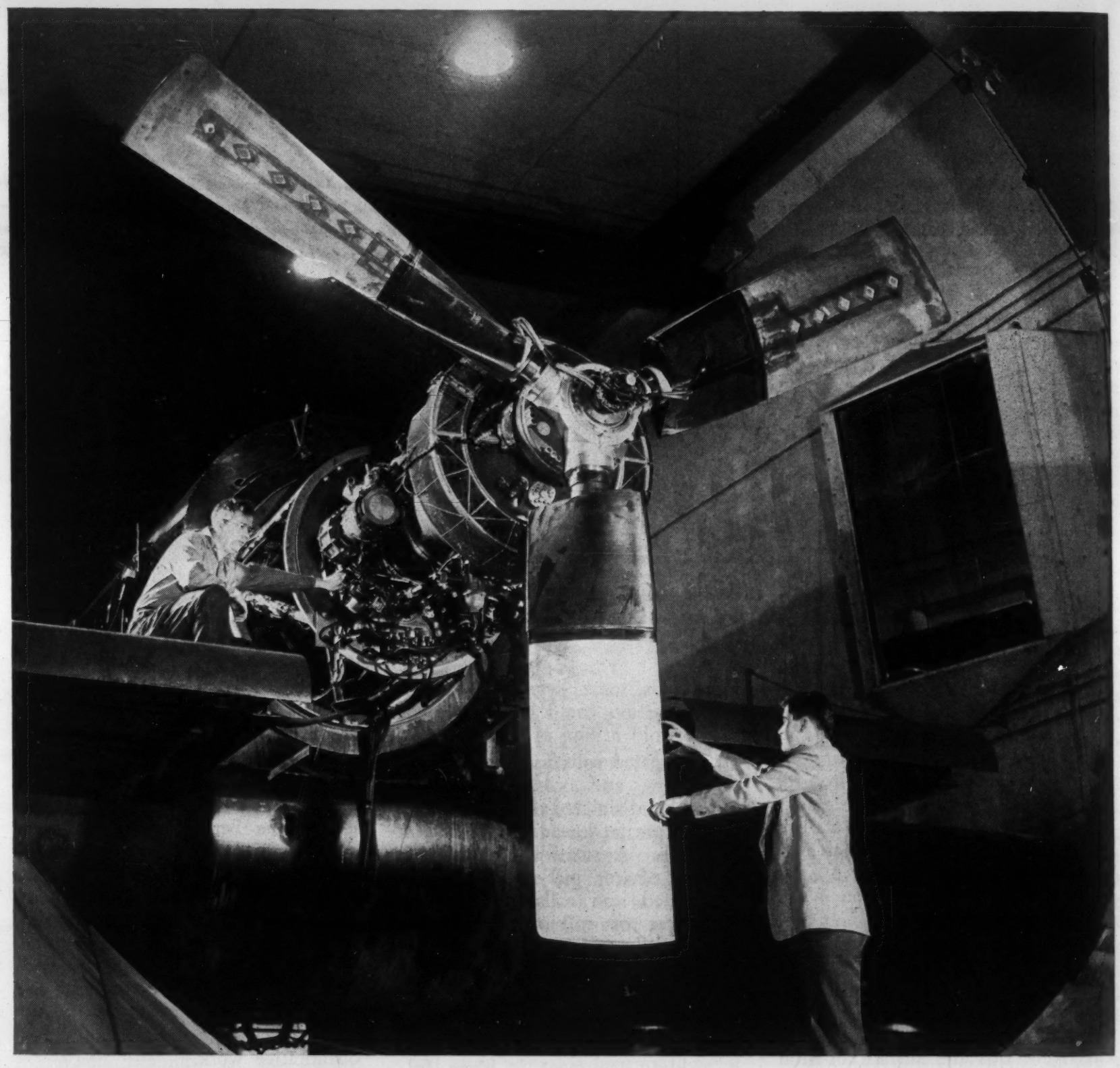
Titanium is surface hardened during hot working by the formation of a tightly adhering oxide skin. Since the oxide surface is somewhat resistant to acid attack, pickling is best done in a standard sodium hydride unit. A water rinse and a brightening dip in a dilute hydrofluoric, nitric acid mixture follow.

Materials at Work

Here is materials engineering in action . . .

New materials in their intended uses . . .

Older, basic materials in new applications . . .



WIDE BLADE AIRCRAFT PROPELLER A new aircraft propeller stated to incorporate the widest blades ever built has been placed in limited production by Hamilton Standard Div. of United Aircraft Corp. It is reported that this propeller, when mounted on a 5500-h.p. Pratt & Whitney Aircraft T-34 turboprop engine, will give more propulsive thrust for take-off than any other propeller-engine combination in a similar advanced stage of development.

The propeller has been selected by the U. S. Navy for its R7V-2 turboprop version of the Lockheed Super-Constellation transport, which will fly this year. Considerable performance increases of the airplane over its piston-engined counter-part are expected.

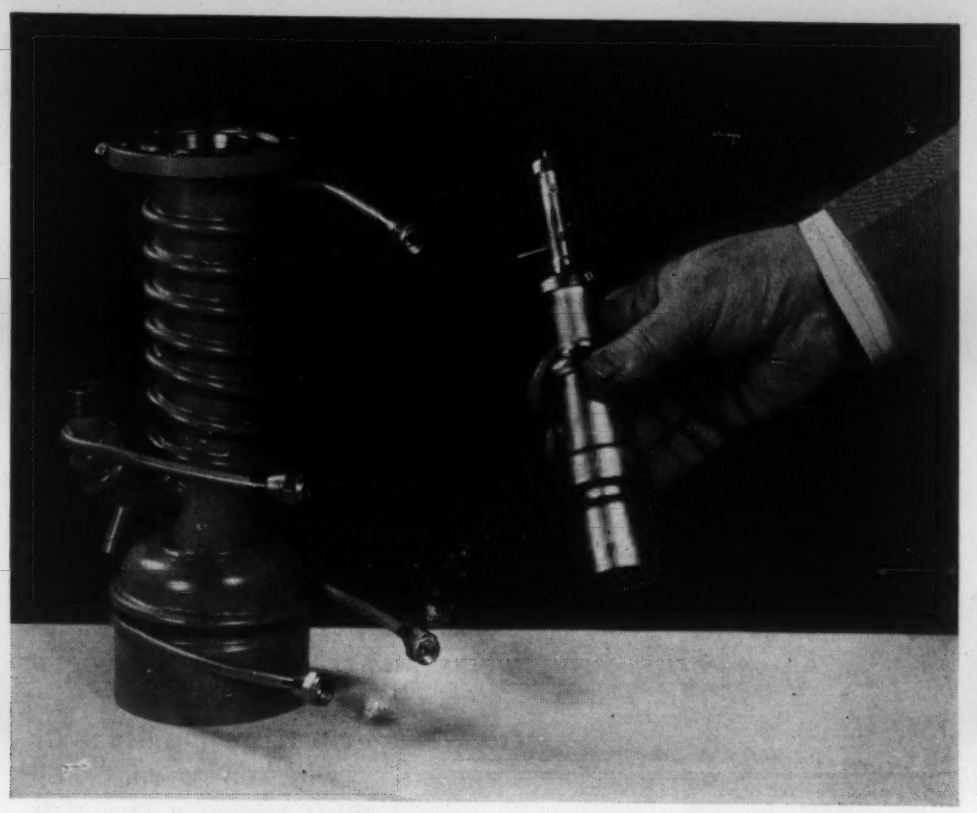
The blades are of hollow steel construction supported internally by a steel core. Air spaces in the blade are filled subsequently with a Buna N and Nylon combination. This foamed synthetic sponge gives a light rigid support to the shell and also forces internal de-icing wires against the leading edge of the blade.

POLYESTER RESIN PREVENTS CONCRETE DUSTING A thin coating of Vibrin polyester resin produced by the Naugatuck Chemical Div. of U. S. Rubber Co. protects the giant Cosmotron at Brookhaven National Laboratory from damage by abrasive particles from the massive concrete radiation shields that surround it.

The $8,000,000 Cosmotron, which is being used in a hunt for basic facts about the atom, is shielded for more than 100 ft around its circumference by a series of 10-ton concrete blocks stacked four tiers high. The blocks protect scientists working at controls and experimental equipment from radiation emanating from the Cosmotron during operation.

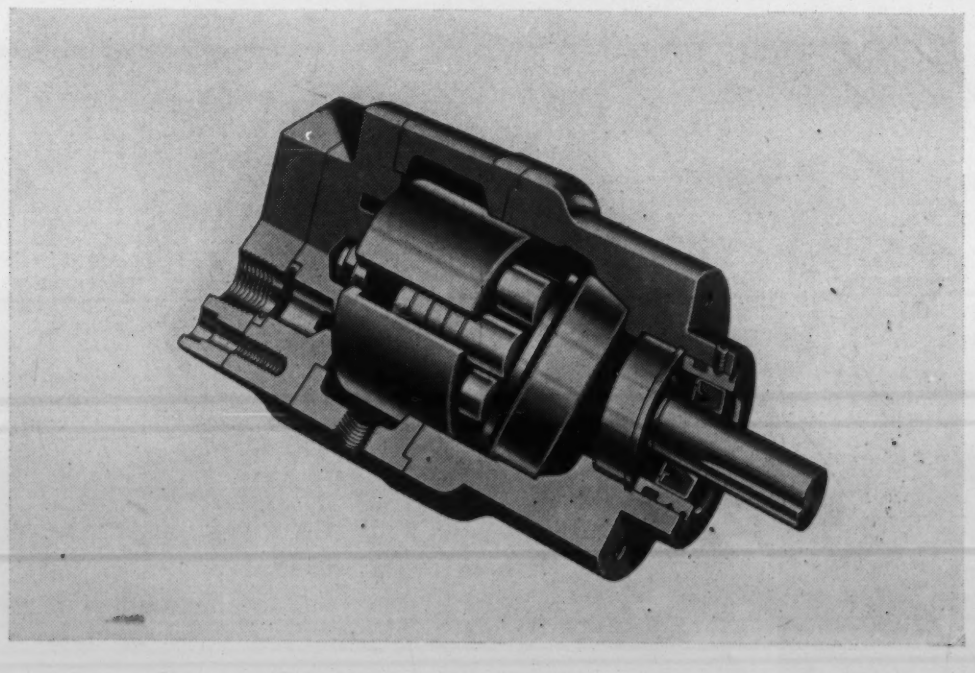
Because the Cosmotron is a delicate piece of machinery, it is necessary to keep the 200-ft long room virtually dust-free. One of the problems is preventing the concrete shielding blocks, which are occasionally moved, from causing dust. A 1/32-in. coating of Vibrin seals the cement block with a hard, glass-like surface, thus eliminating the concrete dust problem.

Materials at Work

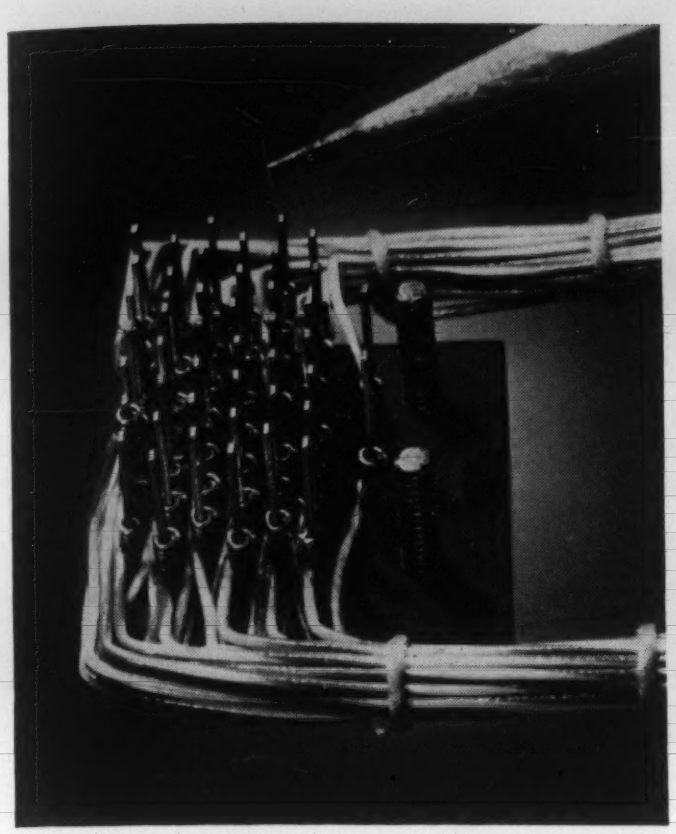


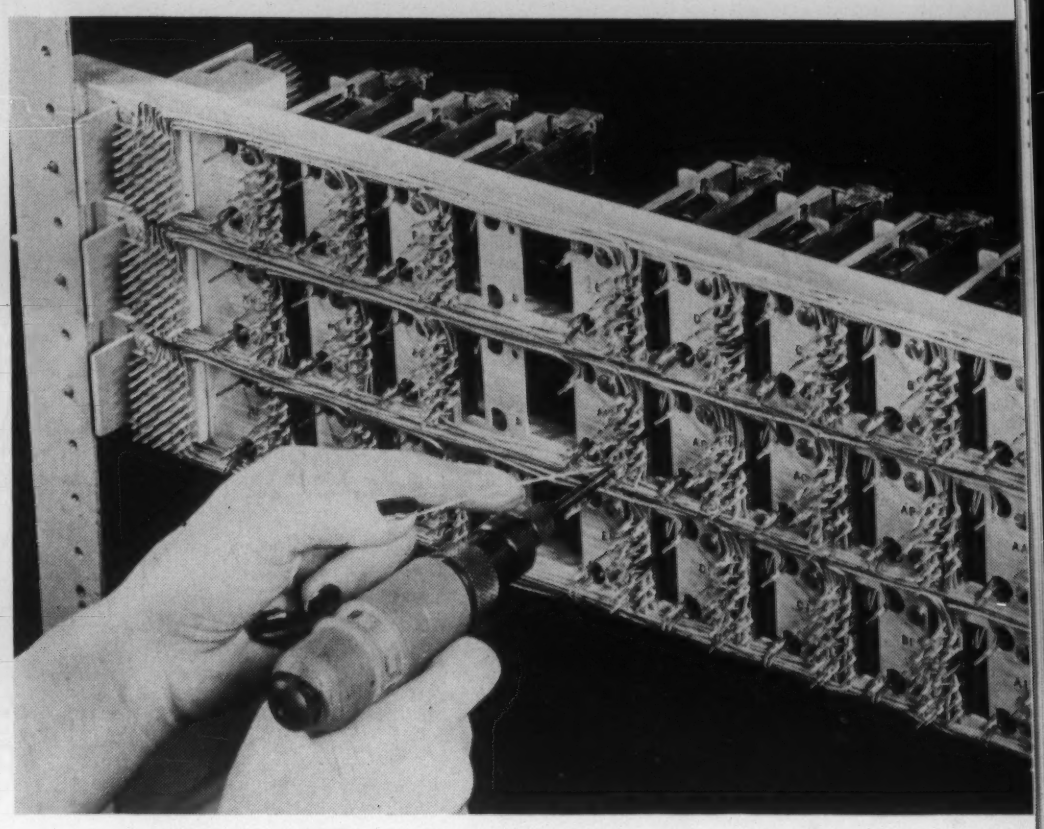
DIFFUSION PUMP COATED by ELECTROLESS NICKEL PROCESS To prevent corrosion during down-cycles and to maintain a clean internal surface, the Eastman Kodak Co. protects its MCF diffusion pump with a nickel coating. Formerly dull nickel plated, these pumps are now coated by the electroless nickel process. This procedure has resulted in an estimated 70% reduction in plating cost and eliminated losses caused by damage during assembly of separately coated components. The electroless nickel process permits the coating of major sub-assemblies rather than components. In this particular pump the complete body assembly is coated in one step, the complete jet assembly in another.

HELIARC-WELDED INCONEL TRAYS Acid-dip trays produced by the C. E. Howard Corp. were welded by the Heliarc process to obtain smooth joints which would not trap acid. These trays, produced from 1/8-in. thick and 1/2-in. round material, weigh 63 lb each. They were welded by the Linde inert-gas arc process using an HW-10 torch at a speed of 15 to 18 in. per min. The shielding gas was argon and the electrode 3/32 in. thoriated tungsten. No after weld cleaning was done since no flux is used in the process.



CONTINUOUS CAST BRONZE The Denison Engineering Co. is using Asarco continuous cast bronze produced by the American Smelting and Refining Co. for various parts in their hydraulic pumps and fluid motors. These pumps range in operating capacities to 5000 psi and are used on many heavy duty installations. Benefits from the use of continuous cast bronze are: Less cost through reduced machining time and less scrap. The parts are reported to have a higher strength characteristic of more homogeneous properties and much better suited from a manufacturing standpoint than former methods. For example, the stock may be machined through screw machine methods, and this has been a saving over former methods. Outside dimensions may be cast much closer to the actual requirement and processed with a minimum of machine waste.

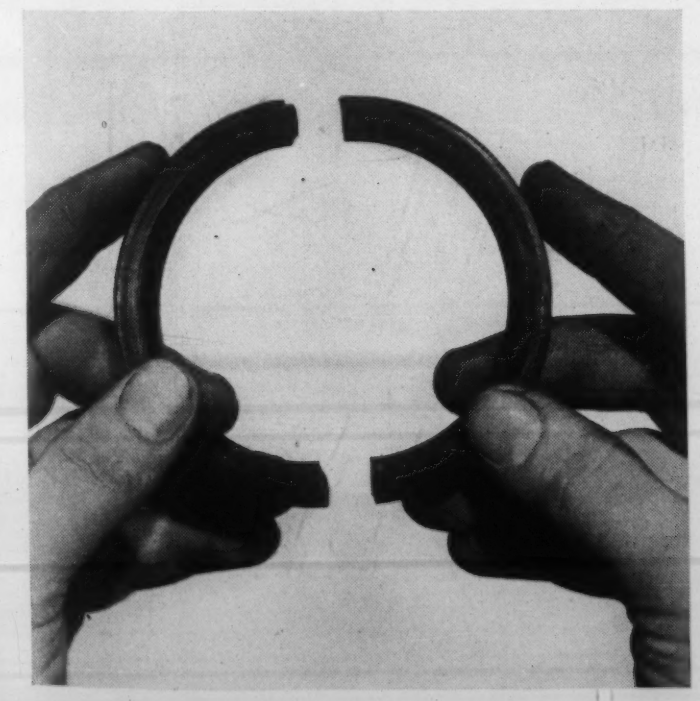




WIRE-WRAPPING TOOL MAKES SOLDERLESS CONNECTIONS A wire-wrapping tool, jointly developed by engineers of Bell Telephone Laboratories and the Western Electric Co., is said to produce, without the use of solder, a gas-tight joint between terminal lug and the connecting wire in the assembly of electrical, electronic and electro-mechanical equipments.

The tool for making these solderless connections is a hand-held gun, either air or electrically operated, that has a rotating spindle with an axial opening that receives the wire terminal and a smaller axial opening into which the skinned end of the connecting wire is inserted. The gun rotates its spindle, which virtually shoots the wire around the terminal in a tight helix, making a firm mechanical metal-to-metal joint. Automatic positioning of the spindle facilitates loading; controlled tension makes highly uniform wraps. Rectangular terminals, having sharp edges, are wrapped with about six turns of wire without the application of heat. Contact pressure in the finished connection is at least 15,000 psi, which results in an indentation at each of the four terminal corners that requires a 10-lb force to strip.

In manufacture, wire wrapping is faster, more uniform, and easier on the operator than soldering. With the solderless connection, terminals can be made smaller in cross section, and spaced more closely together. Since the connection requires a minimum of space, equipment can be reduced in size.

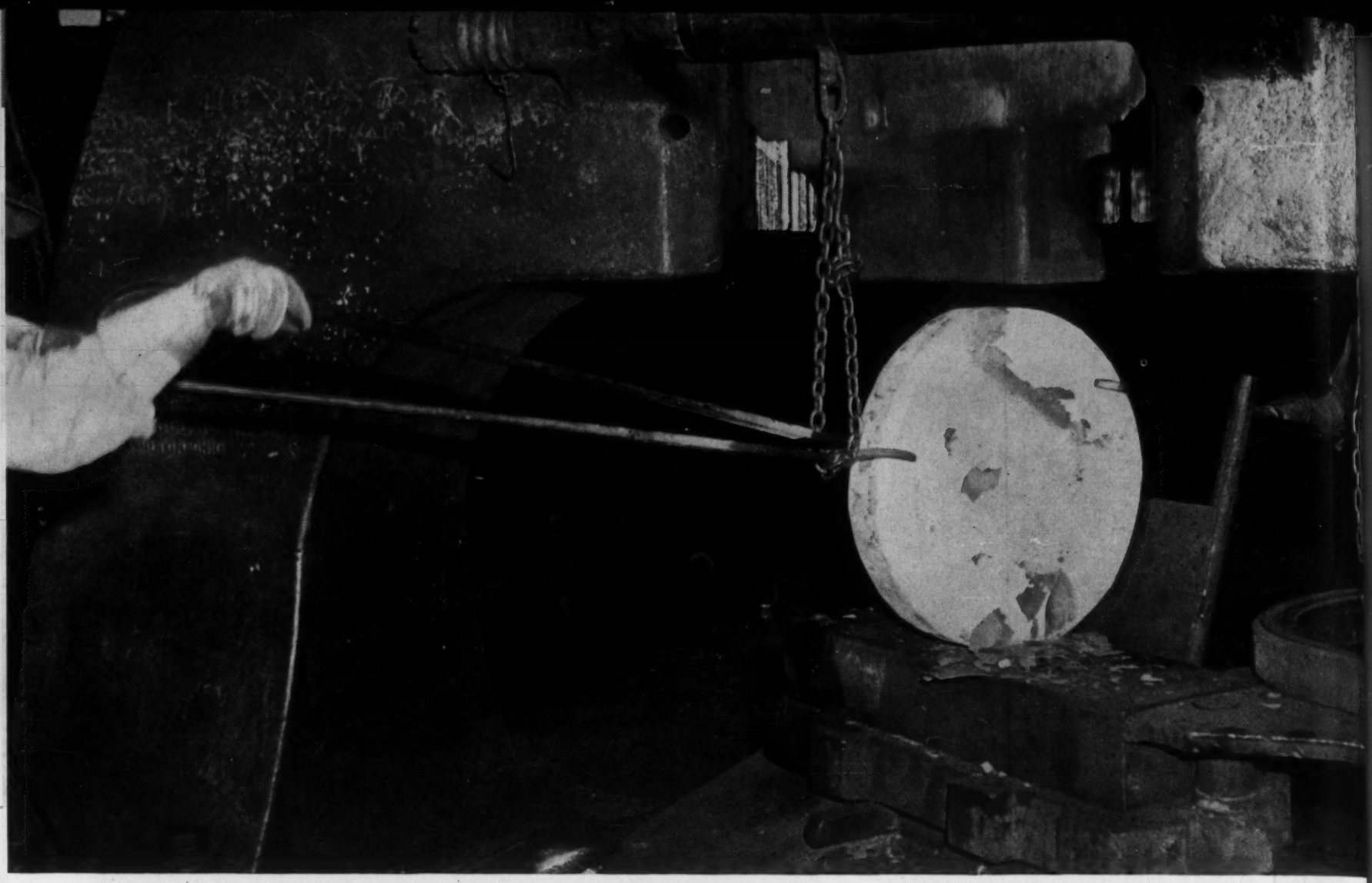


RUBBER BEARING-TYPE SEAL A positive, two-piece bearing-type seal to prevent oil leakage from rear main bearings of automotive engines has been developed by the Brummer Manufacturing Co. The seal is made of Hycar American rubber, a product of B. F. Goodrich Chemical Co.

This seal replaces rope or wicking seals as well as incorporating a new technique in shaft sealing. The oil resistant Hycar is precision molded into a lip-type seal on a half-circle U-channel metal band. By fitting two of these half-seals around the crankshaft and tightening together, a positive oil seal is obtained. The assembly is similar to that of the bearings.

The metal base of the seal prevents distortion and the rubber covering is molded to tolerances as close as the bearings and grind of the crankshaft. The ends of each half-seal are finely ground to form a perfect circle when assembled around the shaft.

Engine speeds up to 4800 rpm mean high temperatures and severe abrasion. Hycar rubber resists the damaging effects of temperature changes, abrasion, automotive oils and greases with added detergents, and engine acids.



Edging the diameter of 800-lb disk preparatory to closed-die forging.

Annealing Type 414 Stainless Steel Forgings

by **ANTHONY A. SCAFATI,** Plant Metallurgist, McWilliams Forge Co.

Closed-die forging of a stainless steel disk.

Optimum hardness and machinability can be obtained with this two-stage annealing procedure.

● MOST MARTENSITIC chromium steels, which contain from 11 to 18% chromium, have very good hot working properties and are widely used in the production of forgings. But cooling from the forging temperature leaves the steels in a very hard condition because transformation from austenite to ferrite in these highly alloyed materials is so sluggish. Air-cooling is usually sufficient to form martensite and develop practically full hardness. Therefore, annealing is required to prevent cracking and for machining operations.

Type 410, the basic composition of this martensite group, can develop high mechanical properties by heat treatment, but it is less resistant to corrosion than the higher chromium or chromium-nickel steels. To increase the corrosion resistance, Type 414, containing 1.25 to 2.50% nickel was developed. Although this nickel addition increased the corrosion resistance of the steel, the nickel also stabilized the austenite and lowered the critical range. As a result, Type 414 responds more slowly to heat treatment than the standard 12% chromium grade.

The straight chromium steels can be fully annealed by slow-cooling from above the critical temperature range. For maximum softness, the general practice is to heat the steels in the range 1550 to 1600 F, furnace cool slowly to 1100 F, and air cool. Sufficient softening for most purposes can be achieved more quickly by air-cooling from 1250 to 1300 F.

However, Type 414 is difficult to anneal to low hardness values because it does not respond to slow cooling from above the critical temperature. The nickel stabilizes the austenite and makes transformation on cooling so slow that impractically long cooling cycles would be required. A study of dilatometric cooling curves confirms the extreme sluggishness of the austenite transformation through the Ar_3-Ar_1 temperatures. Type 414 is generally softened by sub-critical or process annealing. The usual method is to heat the steel at 1200 to 1300 F for sufficient time to obtain soft tempered martensite. It is generally stated that a hardness below 240 Brinell cannot be obtained in practical plant operations.

At McWilliams Forge Co., Type 414 steel is widely used. Large disks, weighing from 700 to 800 lb. are forged from 12 to 18 in. billet sections and reduced to a thickness of 3 to 4 in. and diameters up to 30 in. Four and 6 in. rounds are upset and rings of many sizes are produced.

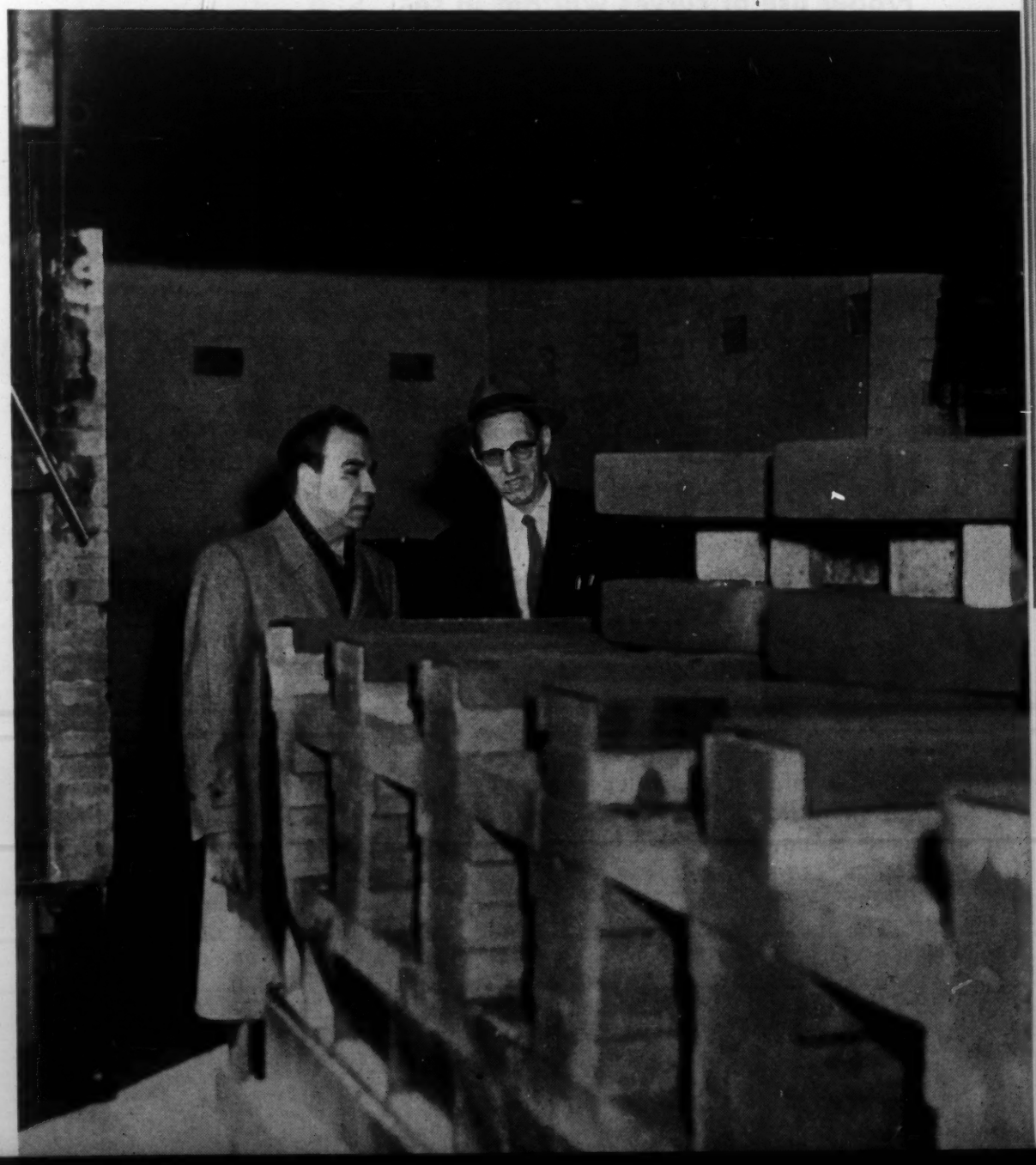
To permit subsequent machining operations and to obtain desired mechanical properties, it is necessary that forgings be annealed from an as-forged Brinell hardness range of 363 to 388 to the range 217 to 248.

In order to attain this, our practice consists of carefully charging the furnaces so that the pieces to be annealed are separated and exposed to uniform furnace temperatures. This is very important! The charge is heated to 1400 F, slightly above the critical temperature and soaked long enough to remove all forging strains and achieve desired homogeneity. The cycle then consists of a two stage operation. In the first, the temperature is dropped to 1300 F and held for a minimum of 14 hr. In the second, the charge is held for 16 hr at 1240 F. The charge is then furnace cooled to 1050 F and rapidly cooled in air. The annealing is done in oil-fired furnaces which are large enough to hold a ten ton charge, thus making this a thoroughly practical operation.

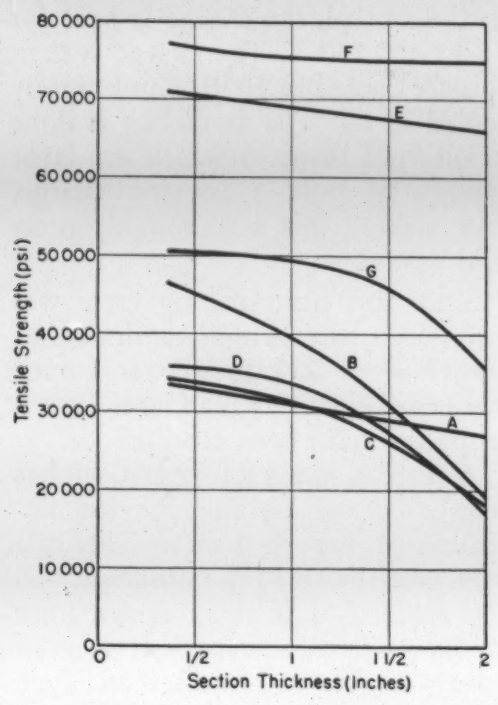
Since this heat treating cycle was introduced, the Brinell hardness has ranged from 217 to 229 and optimum machinability and mechanical properties have been reported.

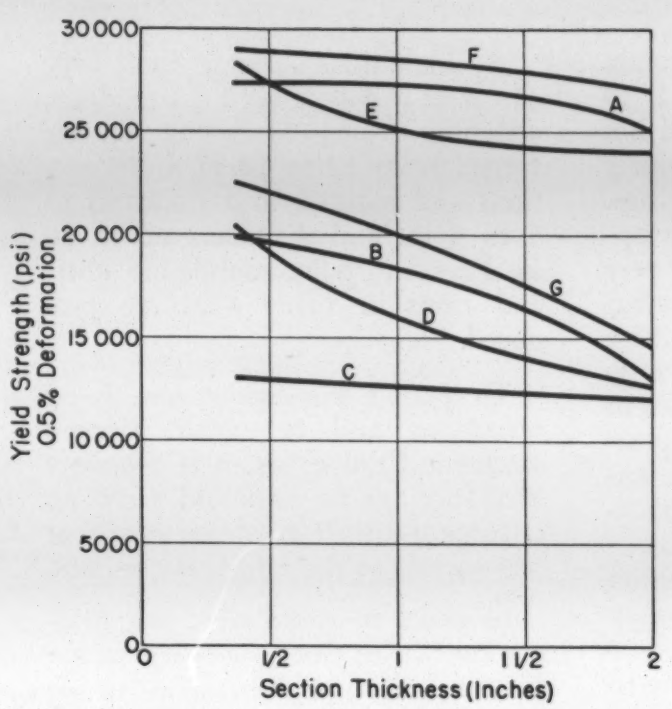
A similar cycle of operation has been used successfully for the annealing of Type 431 steel. This material containing 17% chromium and 2% nickel is just about at the limit of the martensitic range. It is even more sluggish to anneal than Type 414. The usual recommended annealing procedure for this steel is to air cool from 1150 to 1225 F. With this annealing method the commercial hardness minimum is given as 255 Brinell. Using the McWilliams process, hardness values of 235 to 241 are obtained regularly.

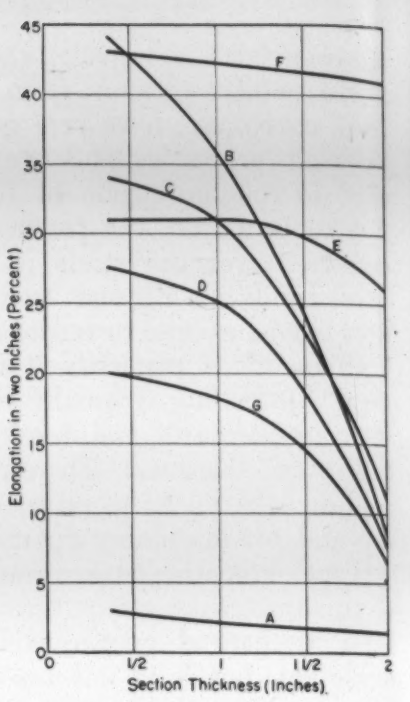
Charging 800-lb forged disks for annealing. Careful arrangement of the disks assures the uniform temperature distribution essential for satisfactory annealing.



These Curves Show . . . .







How Section Size Influences Strength Properties of Sand Castings

Proper use of curves will aid in selecting proper alloy and thickness.

by W. J. REICHENECKER, Materials Div., Westinghouse Electric Corp.

● ONE OF THE many factors that influence the mechanical properties of sand cast alloys is the effect of section thickness upon strength and ductility. In general, as the cast section thickness increases, the unit mechanical properties decrease. Normally, the mechanical properties obtained on ½ in. dia tensile test bars serve as a basis for the selection or the application of the material. It does not always follow, however, that the casting will have properties equivalent to those of the test bar and this is particularly true of castings of a thickness greater than ½ in. Not all alloys show the same degree of susceptibility to loss in mechanical properties with increased section thickness and, therefore, there is no single rule which the designer or engineer can apply in all cases.

The need for information concerning the susceptibility of some of the commonly used nonferrous casting alloys to loss of mechanical strength with increasing section thickness prompted a study of this phenomenon.

As with any test, the selection of the type of specimen is important and must be considered carefully if the results are to be valid. For this work, a specimen having various section thicknesses, but not excessively complex in design was used (see the accompanying sketch).

In addition to section size variations, there are other factors such as pouring temperature, gating and risering techniques, casting geometry, melting practice, etc. that exert an influence upon the mechanical properties of the casting. No single test procedure can encompass the full range of techniques necessary to the production of a wide variety of casting alloys or casting designs. Therefore, the gating and risering technique used in making the step bar casting was selected as being representative of commercial practice and is not necessarily the best technique for all the various alloys examined. Pouring temperatures were selected for each alloy within a range normally used commercially for the particular material being cast. All samples were cast in conventional green sand molds.

The mechanical properties were determined on tensile specimens machined from the different sections of the step bar casting, and the results are shown graphically in the accompanying charts. Minimum mechanical properties, alloy designation, and nominal chemical composition of the alloys examined are given in the table.

Effect of Thickness

All the alloys examined showed a decrease in mechanical properties as section thickness increases. The manganese and aluminum bronze alloys (E and F) appear to be least affected by variations in section thickness whereas the tin bronze alloys are affected to a much greater extent. Heat treated aluminum alloy

(A) does not show too great susceptibility to the section size effect and the silicon bronze alloy is relatively unaffected in section below about 1-½ in. thick.

It should be emphasized that the values shown in the charts should not be construed as typical of these alloys for the section thickness indicated under all circumstances. There are many other factors, previously mentioned, that also have an influence on the properties obtained in a casting of a given alloy. Furthermore, there are techniques available to the foundryman, that will partially offset this natural tendency toward lower properties in heavier sections. Such practices as the use of chills adjacent to heavy cast sections, exothermic riser compounds, insulating riser sleeves, and relocation and redesign of gates and risers are all effective in reducing the detrimental effects of heavier sections when associated with poor feeding.

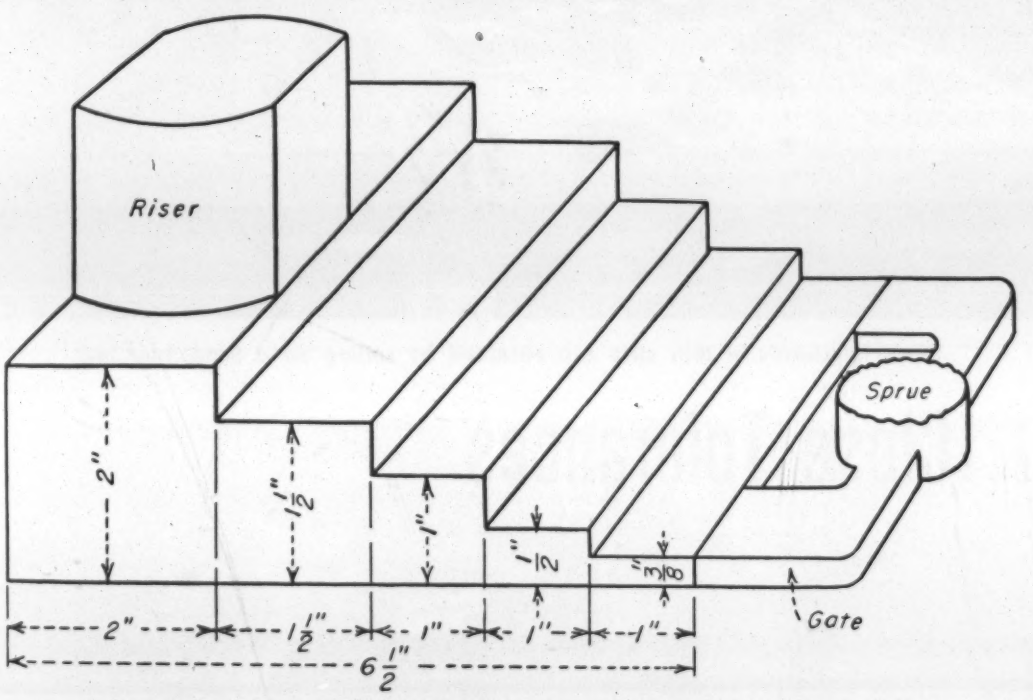
Effect on Design

At Westinghouse, the information on the influence of section size upon mechanical properties was furnished the designer, not to discourage the use of alloys showing the greatest susceptibility to loss of mechanical properties in heavy sections, but to provide additional aid in selecting an alloy for particular design. Conversely, this information also provides for better design for the application of a particular alloy. For example, increasing the section thickness from 1 to 2 in. for a tin bronze alloy, such as alloy B, does not necessarily double the load carrying capacity of the section. Reference to curve B in the tensile strength chart shows that the tensile strength decreases from about 40,000 psi in a 1 in. section to 20,000 psi in a 2 in. section. Therefore, in designing for an alloy of this type, careful consideration should be given to relative section thicknesses and their influence on unit mechanical operations.

Reduction of cast wall thickness is not necessarily accompanied by a proportional loss of mechanical properties. Castings intended for pressure tightness can, therefore, be designed with minimum wall sections consistent with mechanical requirements and in addition obtain improved pressure tightness because of the reduced all thickness.

In the case of an aluminum bronze alloy, alloy F, the mechanical properties are relatively unaffected by increased section thickness up to about 2 in. thick, and thus an increase in section thickness will be accompanied by an overall gain in load carrying capacity.

The information presented should not discourage the engineer from using the alloys showing the greatest susceptibility to loss in mechanical properties in heavy sections, but should provide additional aid in selecting an alloy for a particular casting. On the other hand, reference to these data may help in improving casting design for application of a specific alloy.



Sketch shows general design features of step bar casting.

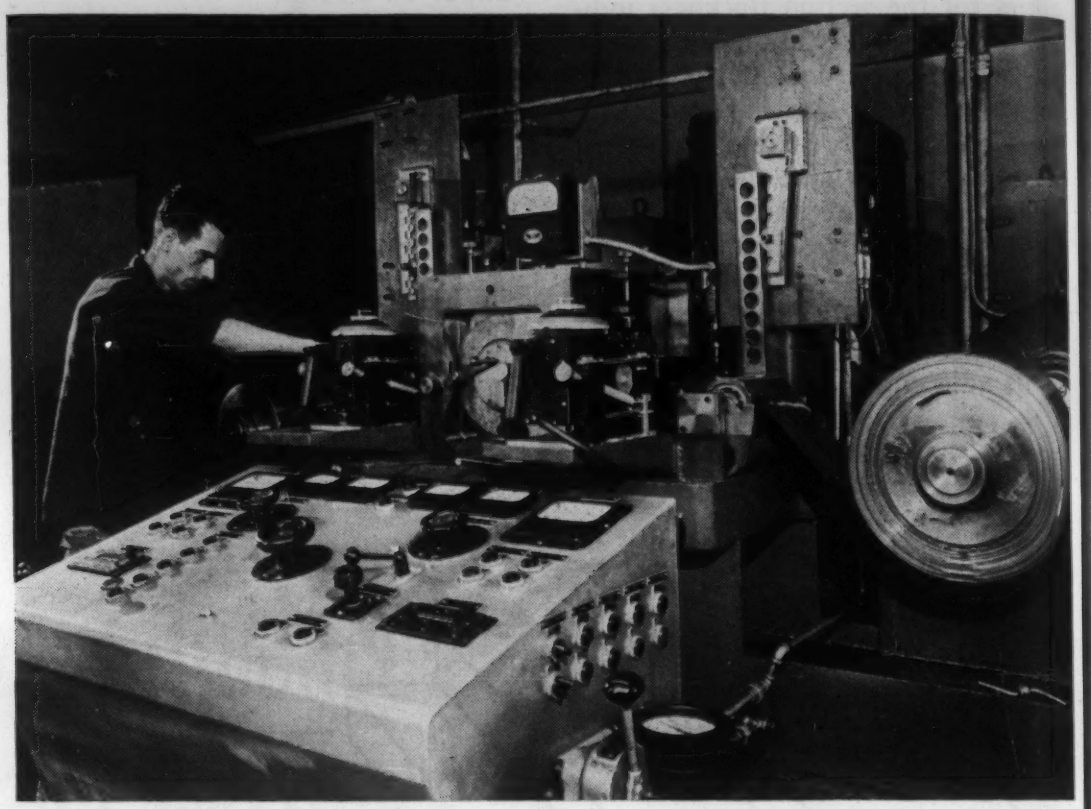
Composition and Minimum Mechanical Properties of Test Bars

	Aluminum Alloy	Tin Bronze 88-8-4	Red Brass	Tin Bronze 85-5-5-5	Manganese Bronze	Aluminum Bronze	Silicon Bronze
ALLOY DESIGNATION	A[1]	B	C	D	E	F	G
SIMILAR ASTM SPECIFICATION	B26–48T SC51A	B143–49T 2B	— —	B145–49 4A	B147–49 8A	B148–49 9A	B198–49 12A
NOMINAL CHEMICAL COMP., %	Cu — 1.25 Si — 5.00 Mg— 0.50 Al —93.25	Cu —88.0 Sn — 8.0 Zn — 4.0	Cu —87.0 Sn — 3.0 Pb — 2.5 Zn — 7.0	Cu —85.0 Sn — 5.0 Pb — 5.0 Zn — 5.0	Cu —59.00 Mn— 0.80 Fe — 1.25 Al — 0.80 Zn — Bal.	Cu —88.5 Al — 9.0 Fe — 2.5	Cu —93.7 Si — 4.5 Fe — 1.8
MIN MECHANICAL PROPERTIES[2]							
Tensile Strength, Psi	32,000	35,000	27,000	30,000	60,000	65,000	45,000
Yield Strength, Psi	20,000	18,000	12,000	14,000	22,000	25,000	20,000
Elong in 2 In., %	2.0	20	20	20	25	20	13

[1] *Alloy "A" was tested in the solution treated and aged condition.*
[2] *½ in. dia sand cast test bars.*

Precision Rolled Thin Strip Offers:

Strip rolled to thicknesses of 0.00015 in. available commercially. . . . Simplifies miniaturization problems. Mirror-finished strip also obtainable. . . . Reduces finishing costs.



Close tolerances in thin strip are obtained by rolling on a Sendzimer mill.

1. Close Tolerances

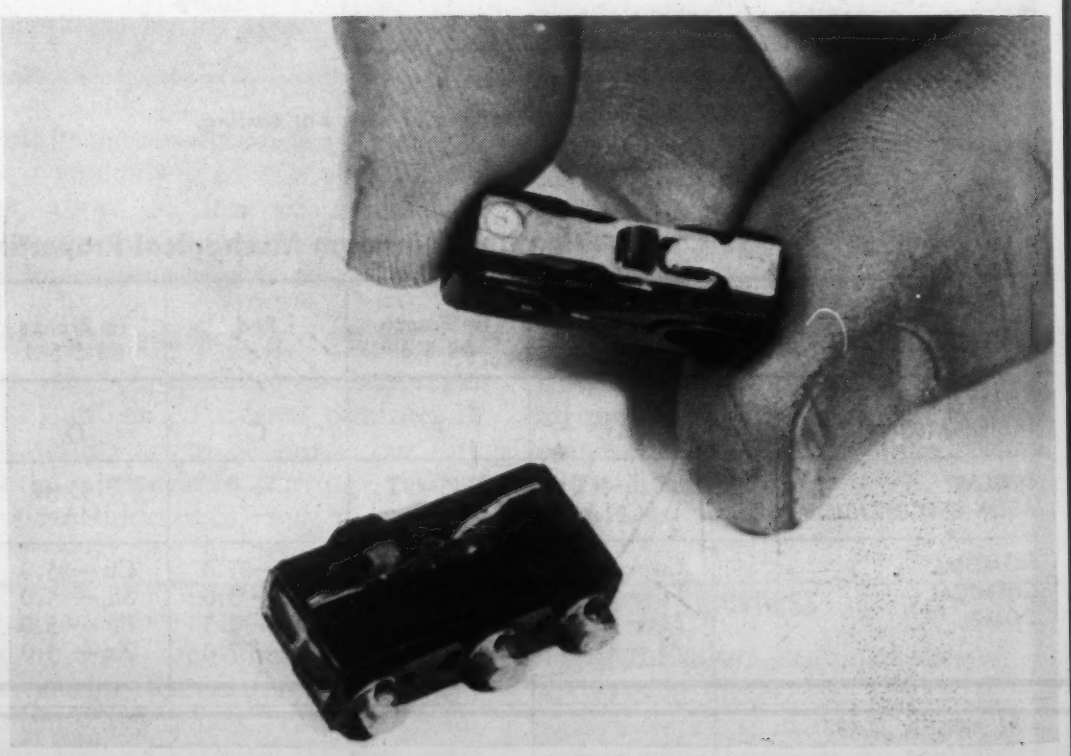
● PRECISION IN instruments, servomechanisms, electronics and aircraft parts calls for measurements in tenths of thousandths rather than in thousandths, requires surface smoothness designations expressed in microinches, and involves hardness specifications defined by Brinell or Rockwell numbers rather than by such terms as "half-hard". In addition, modern engineering design requires narrower ranges and more exacting values of elongation, tensile strength, yield strength, modulus of elasticity and grain size.

The engineer can produce a better product more efficiently and more economically when these "exacting values" are in the metals obtained from the producer.

Precision Thickness and Width Tolerances

Over the years, the accepted commercial tolerances established by the ASTM and AISI for the thickness of metals have averaged ±10%. In the heavier gages tolerances are somewhat lower, but in the thinner gages the tolerance range broadens to as high as ±20%. Typically, the ASTM tolerance on 0.002 in. phosphor bronze is ±0.0004 in. The AISI tolerance on 0.003 in. stainless steel is ±0.0005 in.

To the designer who requires a thin flat spring with definite physical values, a variation of 20% or more would be intolerable. For example, strip metals used in modern auto-



Polished rolls produce beryllium-copper strip with superior surface qualities and lead to increased fatigue resistance of snap acting switches.

2. Superior Surface Qualities

by A. I. NUSSBAUM, Manager, Industrial Div., American Silver Co., Inc.

motive controls must meet thickness tolerances of ±1% to ±5%. Not only is this true of spring materials but it applies to diaphragms, bursting disks, metal bellows, fuse elements and thermostatic bi-metal elements as well. Thickness specifications for the 0.0128 in. gage beryllium copper clips used in sub-miniature tube sockets demand a tolerance of ±0.0005 in. with the additional restriction that the total variation along the length of any one coil must not exceed 0.0003 in. When the present compact assemblies are miniaturized, and then sub-miniaturized, watch-like accuracy is necessary and parts must be machined to tolerances often as close as ±0.0001 in. Usually these parts must be precision ground and lapped at great expense. By blanking from precision-rolled metal, tremendous savings can be made.

Where the part is too thick to be blanked, modern practice calls for machining to commercial tolerances and adjusting the assembly with microshims which can now be procured in thicknesses from 0.0005 to 0.010 in. in increments of 0.0002 in., rolled to a tolerance of ±0.0001 in.

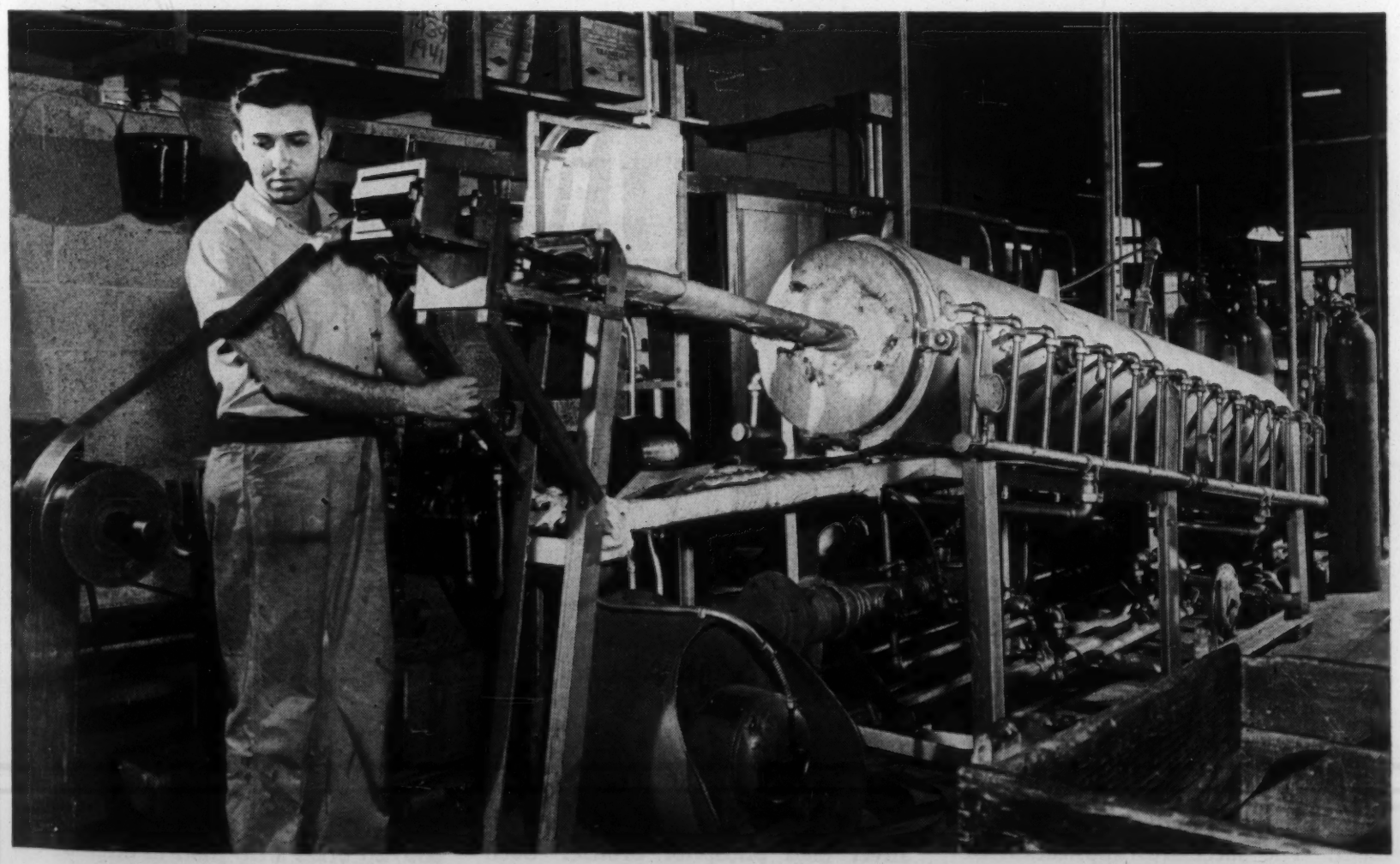
For economy, too, precision thickness tolerances are important. It has been estimated that more than three million tons of steel could be saved each year if steel mills could hold thickness tolerances to within ±3% instead of ±10%, inasmuch as it is customary practice to endeavor to produce with the tolerance on the high side.

If a rectangular flat spring must have accurate dimensions it is customary to blank the part from strip. Strip slit to precision width tolerances, as close as ±0.0015 in., permits the production of such parts with a simple cut-off tool. Scrap is eliminated, and there are important savings in die costs and labor. Resistance ribbon formerly made from flattened wire is now made from precision slit strip at a sizable cost saving.

Surface Finish

For many applications it is important that metal strip have a perfect surface finish, free from rolled-in dust and dirt, pin-holes and other imperfections.

One of the most expensive and time consuming operations in metal working plants is polishing and preparation for electroplating. In many



Continuous annealing in controlled atmosphere furnaces produces strip with controlled grain size and hardness.

3. Controlled Grain Size and Hardness

cases this is strictly a manual operation. Even where automatic polishing equipment is used there is a considerable amount of hand labor involved. Much of this polishing is necessitated by surface imperfections that exist in the metal as it is received from the supplier.

Most strip metals are now available rolled to a mirror-finish and bright annealed and some mills accept orders with a surface finish specification expressed in micro-inches. The premium charge for this extra quality is more than off-set by the labor saving that is achieved, especially where the parts involved are small in size and, consequently, there are a great number of them to the pound.

Clutch disks requiring a perfect surface finish to obtain maximum slippage were formerly lapped from commercial strip to low micro-inch readings. Now they are blanked directly from strip in the as rolled condition that was processed on micro-finished rolls under dust-controlled conditions.

One of the problems encountered in the use of springs made of thin sections is fatigue failure. Investigation has shown that fatigue fracture is usually due to surface imperfections. For example, rolled-in dust causing an 0.0005 in. depression in the surface of a beryllium copper spring 0.003 in. thick creates a 16 2/3% notch. Microscopic examination of fatigue failures in thin springs show many cases where the cracks have started at such a notch. These springs are now made from strip which has a high finish as rolled, obtained by careful handling and dust-controlled production. Fatigue properties have been improved greatly.

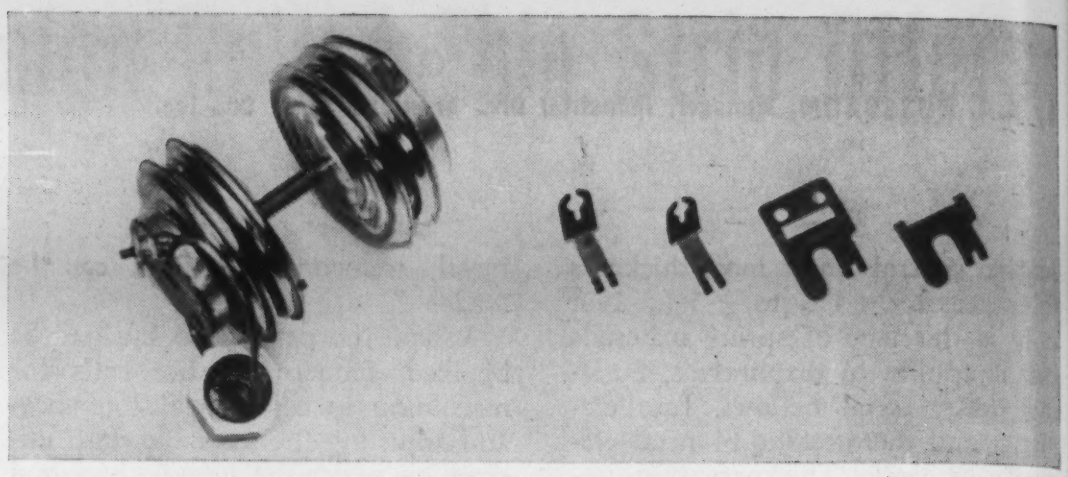
Ultra-Thin Gages

As aircraft and missiles become larger and their fuel loads increase, the size and weight of each individual component part is receiving critical study from the standpoint of weight. Thus, miniaturization, and now sub-miniaturization, have become the keynote in design for aircraft. Similar design problems are met in communications, instrumentation, electronics and electrical equipment. The successful application of the miniaturization concept is largely dependent on the availability of the stronger metals in thin and ultra-thin strip gages.

Once it was realized that there is a definite relationship between the work roll diameter of a cold strip mill and the thinnest gage of strip which the mill can produce, the need for cluster mills with extremely small work rolls became evident. Both the Rohm mill and the Sendzimir mill are machines of this type and have been made with work roll diameters as small as 1/4 in. The Sendzimir mill is probably the most widely used cluster mill today and is in use in the processing of both ferrous and nonferrous metals down to gages of 0.00015 in.

Some of the more important applications of various metals and alloys in ultra-thin gage strip form are given below.

Stainless Steels—Instrument membranes
Carbon Steels—Thickness gages
Titanium Alloys—Camera Shutters
Tantalum—Capacitors
Beryllium-Copper—Diaphragms and bellows
Phosphor Bronze—Sliding contacts
Brass—Computer memory tape
Iron-Nickel Alloys—Tape: wound magnetic cores



Phosphor bronze diaphragms and beryllium-copper contacts are improved by using precision-rolled strip.

Composite Strip Metals

The required physical and chemical properties of strip metal frequently cannot be furnished by a single metal or alloy. However, the desired properties can often be obtained by designing a composite material.

A good example is furnished by silver clad phosphor bronze. Such bi-metal strip is widely used in the electrical switch-gear industry for contact springs. The bi-metal offers the designer both the excellent electrical conductivity of silver and the high strength of bronze. Composite strip is also used widely in thermostats where a large number of different ferrous-to-ferrous and ferrous-to-nonferrous bi-metal combinations furnish almost any desired rate of deflection with temperature change.

The economy made possible by the use of clad metals is another important factor favoring their increasing application. Many contact materials in the electrical and electronic industries, and some corrosion-resistant materials in the chemical industry, are today made of a comparatively thin surface layer of silver, gold, palladium or platinum alloys clad to such base metals as copper, brasses, bronzes, nickel silvers and beryllium copper.

Both nickel-clad and copper-clad low carbon steel strip have been produced in large quantities during the past two years. Such composite metals have usually comprised a 10% surface layer of commercially pure nickel or copper bonded to a core of either C 1008 or C 1010 low carbon steel, with the clad metal strip rolled frequently to gages as thin as 0.005 in. and 0.003 in. Electronic tube components and automotive radiator fins have been among the major applications of nickel-clad and copper-clad steel, respectively.

Finally, clad metal strip is in use in applications where electroplating has proved difficult, impossible or uneconomical. In the manufacture of flexible waveguides, for example, it has been found more economical to fabricate the flexible tubing members from extremely thin silver-clad 80/20 brass strip than to attempt the electroplating of the finished lengths of tubing. In most cases, only slight surface layers of precious metal are required, a common thickness being 0.0003 in.

Rubber Parts

by Philip O'Keefe, Associate Editor, Materials & Methods

MATERIALS & METHODS
MANUAL No. 95

This is another in a series of comprehensive articles on engineering materials and their processing. Each is complete in itself. These special sections provide the reader with useful data on characteristics of materials or fabricated parts and on their processing and applications.

JULY 1953

Parts made of natural rubber or synthetic elastomers have many uses and a tremendous range of possible properties. To help engineers make the best use of rubber parts, this Manual gives information on:

- **How Rubber Parts Are Made**
- **How Rubber Compounds Are Specified**
- **How Rubber Parts Are Designed**
- **Where Rubber Parts Are Used**

Introduction

While automobile tires are probably the most familiar and commercially important rubber products, other parts are equally interesting to various industrial users. Pump and valve diaphragms, hose, bellows, belting, linkage boots, tubing, gaskets, packings, electrical insulating parts, bushings, tape, grommets, handle grips, valve seats and similar parts are made of solid rubber. Parts such as these can be molded, cut from sheet, extruded or machined from stock.

Certain unique properties can be obtained in parts made of rubber. First of all, rubbers can be stretched tremendously; working extensions can be 300% and ultimate elongations 800%. Second, light loads can give large deformations. Working tensile stresses seldom reach 100 psi in soft rubbers. Third, recovery from deformations (resilience) is good, energy storage is large and repeated flexing can be withstood. In addition, rubber is a good electrical insulator in its usual form. Water imperviousness and good chemical resistance are other important characteristics.

The wide variety of properties available in the many different kinds of rubber is perhaps the most attractive thing to users. There is no one basic material. Besides the natural product, there are a number of so-called synthetic rubbers. Each has a different chemical nature, and variations in processing and compounding ingredients make possible big differences in properties.

Every rubber compound has its own advantages and disadvantages, depending on intended use. *Natural rubber* is usually strong, elastic and resilient, with high elongation. Natural rubber is imported, however, and has been subject to scarcities and wide price fluctuations. It is not resistant to oil or sunlight and has temperature limitations. *GR-S* is the most important man-made elastomer. Like natural rubber, GR-S is not oil-resistant. At the present time it is cheaper than standard grades of natural, however, and has nearly as good mechanical properties. *Cold rubber,* which is GR-S polymerized at low temperatures, has improved abrasion resistance and higher strength. *Butyl,* a relatively cheap synthetic, is also non-oil-resistant. Resilience is poor at room temperature, but it is used in tire inner tubes because of outstanding gas-retaining qualities. *Neoprene* is moderately oil-resistant, with good mechanical properties and excellent sunlight resistance. *Buna-N,* or nitrile rubber, has excellent oil and solvent resistance. *Thiokol* has the best oil resistance, but is limited by thermoplasticity and relatively low resilience. *Silicone rubber* is outstanding for stability and inertness at high temperatures and for resilience at low temperatures. Chemical and oil resistance and resistance to compression set are good, but prices are high and mechanical properties are limited. Other synthetics, such as polyacrylic, ester and polyethylene-glycol rubbers, have been developed recently with special properties.

When planning or designing parts to be made of rubber, consultation between designers or engineers and rubber technologists is often necessary. Some large users even keep rubber technologists on their own staffs. The average parts user does not have to go to this length, however, if he understands a few basic principles and takes full advantage of the consultation services offered by suppliers.

Materials & Methods Manual #37 (May 1948) summarized basic rubber properties. It showed how these properties change with additions and processing variations. In the present Manual we carry the subject one step further, explaining how parts made of rubber should be designed and specified. Information valuable to users is emphasized, while the chemistry, manufacturing processes, and nomenclature of producers are covered only where they concern the user. Discussion is confined to molded, extruded, die cut, and machined shapes. Natural and synthetic rubber parts are included, but the rubber-like plastics are not discussed.

How Rubber Parts Are Made

Although the manufacturing processes for rubber parts do not directly concern users, some background is helpful to specifying engineers.

Calendering and Extrusion

The first step is mixing. Natural or synthetic rubber is put into a mill or mixer with fillers, plasticizers, reclaims, vulcanization ingredients, accelerators, anti-oxidants and other compounds.

Vulcanizing agents such as sulfur combine with rubber when heat is applied to form non-tacky, cured compounds. Sulfur content in soft rubber is 0.4%, in hard rubber 25 to 40%. Accelerators speed up vulcanization, while antioxidants reduce deleterious effects of heat and oxygen on cured rubber. Plasticizers can be used either to soften the uncured compound for better processing or to provide certain properties like flexibility at low temperatures in the finished compound. Fillers such as carbon black increase strength for better tear and abrasion resistance in the finished product. For light colored stocks, reinforcements like zinc-oxide, magnesium oxide and magnesium or calcium carbonate can be used for reinforcement.

After mixing, the next step is usually calendering or extrusion, although large, thick pieces can be cut directly from mill slab. In calendering unvulcanized compounds, slab is rolled to sheets of carefully controlled thickness. Uncured material can also be extruded to sizes and shapes desired. Extruded and sheet goods are vulcanized in large heaters by air alone or in combination with steam. Vulcanized products are cut to length, or notched or punched according to specifications.

Extrusion has certain advantages and disadvantages. Setup and die costs are low, and finished parts are comparatively inexpensive. Close tolerances might be difficult to hold, however, depending on the size and shape of the extrusion and the compound used.

Vulcanized sheet or slab stock can be die cut to many shapes using inexpensive steel dies. Flat parts with large holes or cutouts are often cheaper to mold, however, due to waste in die cutting. With thicknesses above 1/8 in., some concavity

develops on punched edges. This is more pronounced the thicker and softer the material is. Holes smaller than half the thickness of the material are difficult to punch satisfactorily.

Molded Parts

Most molded parts are made by compression molding. Enough rubber compound is used so that a flash is formed between the mold plates. Trimming is usually necessary, and a slight flash may be left. Cores and inserts can be used to form holes and inner recesses. Close tolerances can be held on all dimensions except across the mold parting line. Parts are uniform, with good finish. Almost any hardness, color, shape or size part can be made. In comparison with other types of molding, compression molds are relatively cheap and can be operated with relatively low labor cost.

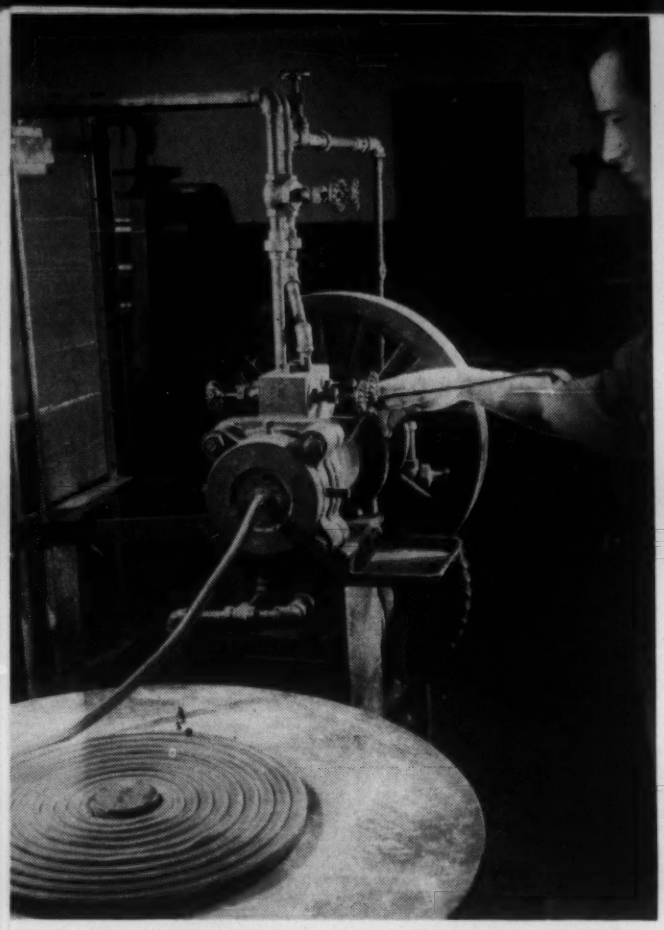
In transfer molding, the mold closes steel-to-steel, minimizing thickness variations in finished parts, so that tolerances are closer than in compression molding. There is practically no flash. Thin cores and inserts can also be used to make some intricate parts not practical to form by compression molding. Good finish can be secured. With transfer molding, mold cost and press overhead costs

Table 1—Comparative Properties of Important Rubber Compositions

	Natural Rubber	GR-S	Buna-N	Neoprene	Butyl Non-Oil Resistant	Thiokol	Silicone Rubber
Specific Gravity	0.93	0.94	1.00	1.25	0.91	1.35	1.2 to 2.6
Tensile Strength, Psi: Pure Gum	3000	400	600	3500	3000	300	200–450
Reinforced	4500	3000	4000	3500	3000	1500	—
Tear Resistance	Excellent	Poor-Fair	Fair	Good	Good	Fair	Poor-Fair
Abrasion Resistance	Excellent	Good	Good	Excellent	Fair	Poor	Poor
Aging: Sunlight	Poor	Poor	Poor	Excellent	Excellent	Good	Good
Oxidation	Good	Fair	Fair	Good	Good	Good	Very Good
Heat (Max Temp), F	300	250	300	300	300	160	450
Static (Shelf)	Good	Good	Good	Very Good	Good	Fair	Good
Flex Cracking Resistance:							
Slow Rate	Excellent	Good	Good	Excellent	Excellent	Fair	Fair
Fast Rate	Excellent	Poor	Poor	Excellent	Excellent	Poor	Poor
Compression Set Resistance	Good	Good	Very Good	Poor or Excellent	Fair	Poor	Good
Solvent Resistance:							
Aliphatic Hydrocarbon	Very Poor	Very Poor	Excellent	Fair	Poor	Excellent	Poor
Aromatic Hydrocarbon	Very Poor	Very Poor	Good	Poor	Very Poor	Good	Very Poor
Oxygenated Solvent	Good	Good	Poor	Fair	Good	Fair	Poor
Halogenated Solvent	Very Poor	Very Poor	Very Poor	Very Poor	Poor	Poor	Very Poor
Oil Resistance:							
Low Aniline	Very Poor	Very Poor	Excellent-Fair	Fair	Very Poor	Excellent	Poor
High Aniline	Very Poor	Very Poor	Fair-Excellent	Good	Very Poor	Excellent	Good
Gasoline Resistance:							
Aromatic	Very Poor	Very Poor	Poor-Good	Poor	Very Poor	Excellent	Poor
Non-Aromatic	Very Poor	Very Poor	Fair-Excellent	Good	Very Poor	Excellent	Good
Acid Resistance:							
Dilute (Under 10%)	Good	Good	Good	Fair	Good	Poor	Fair
*Concentrated	Fair	Poor	Poor	Fair	Fair	Very Poor	Poor
Low Temperature Resistance (Max)	−65 F	−70 F	−65 F	−50 to 65 F	−65 F	−40 to 65 F	−120 F
Permeability to Gases	Fair	Fair	Fair	Very Good	Very Good	Good	Fair
Water Resistance	Good	Very Good	Very Good	Poor-Fair	Very Good	Fair	Fair
Alkali Resistance:							
Dilute (Under 10%)	Good	Good	Good	Good	Very Good	Poor	Fair
Concentrated	Fair	Fair	Fair	Good	Very Good	Poor	Poor
Resilience	Very Good	Fair	Fair	Very Good	Very Poor	Poor	Good
Elongation (Max), %	700	500	500	500	700	400	300

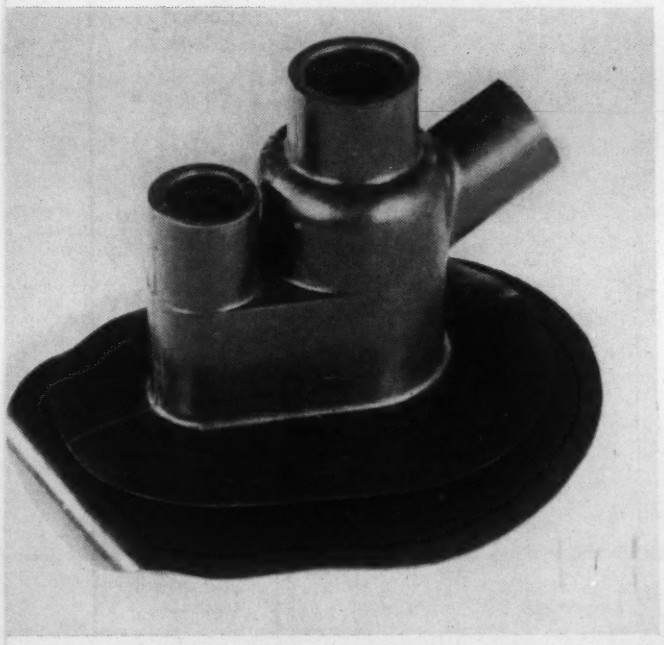
*Except nitric and sulfuric.

(Adapted from data from Linear Inc.)

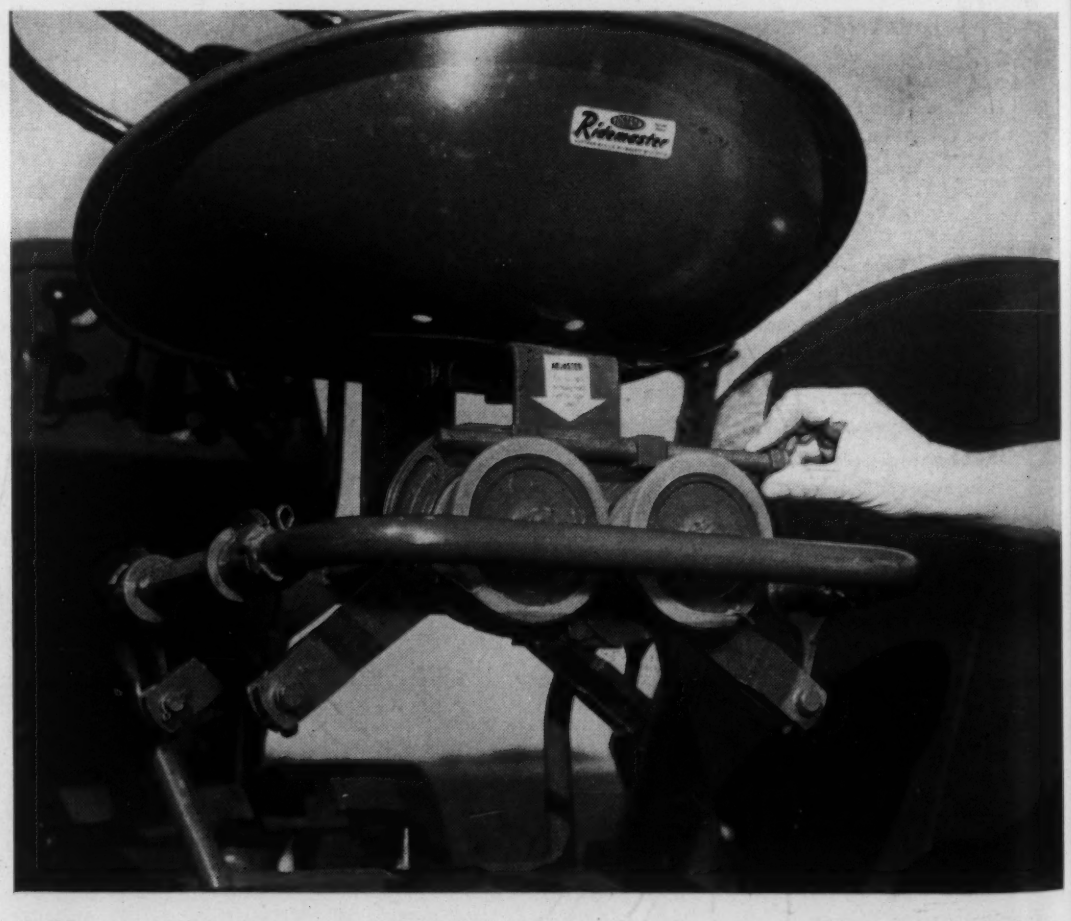


Thiokol hose is extruded on a laboratory machine. Similar hose performs successfully with paint, gasoline and aromatic fuel.

In compression molding, uncured compound is forced into the cavities and cured by heat in the mold. Picture shows pieces being removed after vulcanization.



Aircraft fuel cell fitting requires a split cavity mold with both loose inserts and a permanent insert. The rubber is flexible enough to snap out of the cavity after curing.



Rubber torsional springs are mounted in tractor seat. Springs are the cylindrical objects mounted below the arrow. They cushion shocks and level out sharp rebounds that occur with heavy steel springs.

are generally higher, but labor costs are usually less than in compression molding. Not all compounds will flow suitably for this method. Although flash is minimized, sprue necks must be tumbled or trimmed off. Transfer molding, in general, is best suited to small parts.

Injection molding is relatively new with rubber. The advantages are similar to those of transfer molding —uniformity, close tolerances, good finish and thin trim flash. Change-over and set-up time are relatively long, however. Equipment and maintenance are costly. In general, injection molding is suitable only to long production runs.

Flash removal is often expensive, and allowable flash requirements can greatly affect cost. Punch presses can be used for trimming if 1/32 to 1/16 in. extension is acceptable. Another method is to freeze parts in dry ice, then tumble them. Buffing or hand trim may be necessary for 100% flash removal.

Many molded parts require inserts of metal, fabric or plastics. Steel, aluminum, cast iron, stainless steel, bronze, brass and other metals are bonded to rubber with adhesion strengths that often exceed rubber tensile strength. To obtain adhesion, metals are blasted or cleaned by sandblasting or degreasing, then either brass-plated or covered with rubber-metal adhesive, depending on the metal, the rubber and the application. Fabric reinforcements are impregnated or coated with compounded rubber to ensure adhesion. Inserts are bonded to the rubber in the mold during vulcanization.

Cellular Rubber Parts

Almost any rubber, of any hardness, can be made in cellular form. It can be produced as molded parts or as sheet. The three types of cellular rubber are latex foam, sponge and closed cell.

Latex foam is made by mechanically whipping up liquid latex rubber. The result is a network of interconnecting cells. The material is over 90% air and extremely light, soft and yielding.

Sponge, or open cell rubber, is made by putting a blowing compound into solid rubber before vulcanizing. The compound gives off a gas to form cells. These cells burst to give a uniform structure of interconnecting cells. The expansion is done in a mold or open pan.

Closed cellular rubber is usually made by subjecting uncured solid rubber to high pressure nitrogen. Some gas dissolves in the rubber. When the pressure is lowered in vulcanization, the gas expands to form unconnected cells. The same structure can also be obtained by using gas-forming ingredients. In either case, the gas is not allowed to break the cells.

How to Specify Rubber Compounds

Rubber should be bought to meet predetermined specifications and desired properties. As a general rule, no user should specify by type—i.e. neoprene, GR-S, etc. Mechanical, electrical and chemical properties desired or the service conditions to be met should be described, with the understanding that the supplier can use any compound that does the job. However, when evaluation tests are not entirely reliable, as for tests for weather resistance, it might be advisable to make an exception and specify the type of compound.

Specification Properties and Tests

Classification systems for cellular and comparatively soft rubber developed by the American Society for Testing Materials and the Society of Automotive Engineers are widely used throughout industry. Compounds are specified according to standard and special tests. While these systems are not perfect and are not the only ones used, they are indicative of specifying practice and should be understood by every user.

Accompanying tables show properties available in commercial compounds. These tables are not all-inclusive, but merely indicate the ranges. They also show the mutual dependence of properties. Extreme values cannot be obtained in one property without detracting from others. Outstanding oil or heat resistance, for example, can sometimes only be obtained at a sacrifice in strength.

Hardness—Hardness is measured by pocket durometers which show relative resistance to indentation. A Shore "A" durometer reading of 100 is obtained on a polished steel or glass surface. Hard rubber runs 95 to 99. Tire material tests between 60 and 70. Inner tube rubber varies from 35 to 50, while rubber bands run between 35 and 40. The practical tolerance on durometer requirements is ± 5.

Durometer hardness, although often assumed to be, is not a reliable index of stiffness. Various persons using different durometers sometimes differ by 5 or more points in readings on the same piece of rubber. Since a 5 point difference can mean a variation of 15 to 20% in stiffness measured by compression deflection tests, difficulty of meeting close stiffness requirements is apparent.

Indentation tests are used to classify foam rubber, just as durometer hardness tests classify solid compounds. Indentation tests consist of measuring the load in pounds needed to produce a 25% deflection in a 50 sq. in. piece.

Strength Properties — Tensile strength and elongation are extremely useful, but often misused, measurements. In manufacturing and compounding, tension tests are an important tool. Tests before and after exposure to some deteriorating influence indicate relative resistance of the compound. The relative effects of various compounding ingredients can often be best determined by tests of tensile strength, ultimate elongation and tension modulus. Tension tests are also used for factory quality control.

Tensile and elongation values in themselves, however, are seldom measures of quality. Interpreted in relation to other properties, knowledge of strength and elongation may be extremely useful, but it is a frequent and regrettable mistake of users to require values unnecessarily high for these two measurements, thus limiting other desirable properties or the economy of the products.

Absolute tension values have no dependable significance. A stock with high tensile might or might not have, for example, good flex life. Relative tension values are highly significant; a stock that retains its tensile strength will also retain its flex life (after exposure to deteriorating influence).

Compression Set—Compression set tests evaluate ability to regain original shape after prolonged compression. Cylindrical disks, under constant load or at constant deflection, are heated for given periods. Temperatures are made suitable, if possible, to expected service. Heating is usually only to accelerate tests, however, and results do not correlate directly with service. Comparison with compounds of known service qualities is necessary.

Compression - Deflection — These characteristics are measured by tests at specified deflection and tests at specified load. Cylindrical specimens or completed articles are compressed slowly in standard test machines at room temperature. Results are widely used to classify sponge and closed cellular rubbers. Compression deflection tests are also widely used in specifying desired characteristics of vibration isolating mountings.

Table 2—Physical Property Ranges of

	Basic Requirements									
	Durometer Hardness	Tens. St., Min, Psi	Ult. Elong., Min, %	Max Change With Heat Aging			Comp. Set, Max, %	Volume Change % Limits, Oil Immersion 70 Hr at 212 F		Comp. Set, Max, %
				Durometer Hard.	Tens. St., %	Ult. Elong., %		Petroleum Base Oil Aniline Pt. 124 C	Petroleum Base Oil Aniline Pt. 70 C	
				70 Hr at 158 F			22 Hr at 128 F			22 Hr at 128 F
Non-Oil Resistant Compounds	30 ±5	1000	400	+10	−25	−35	50	—	—	25
		2500	600	+10	−25	−25	50	—	—	35
	40 ±5	1000	400	+10	−25	−35	50	—	—	25
		3000	600	+ 7	−25	−25	50	—	—	35
	50 ±5	500	300	+10	−25	−35	50	—	—	—
		3500	600	+ 7	−25	−25	50	—	—	35
	60 ±5	500	300	+10	−25	−35	50	—	—	—
		3500	550	+ 7	−25	−25	50	—	—	35
	70 ±5	500	150	+10	−25	−35	50	—	—	—
		3000	400	+ 7	−25	−25	50	—	—	35
	80 ±5	500	100	+10	−25	−35	50	—	—	—
		2500	300	+ 7	−25	−25	50	—	—	—
	90 ±5	500	75	+10	−25	−35	50	—	—	—
		1500	125	+ 7	−25	−25	50	—	—	—
				70 Hr at 212 F						
Oil Resistant Compounds Very Low Volume Swell	40 ±5	500	400	+15	−15	−40	65	−3 +5	0 +10	—
	50 ±5	500	400	+15	−15	−40	60	−3 +5	0 +10	—
	60 ±5	700	300	+10	−15	−40	50	−3 +5	0 +10	—
	70 ±5	1000	250	+10	−15	−40	50	−3 +5	0 +10	—
	80 ±5	1000	150	+10	−15	−40	50	−3 +5	0 +10	—
	90 ±5	1000	100	+10	−15	−40	50	−3 +5	0 +10	—
							70 Hr at 212 F			70 Hr at 212 F
Oil Resistant Compounds Low Volume Swell	40 ±5	1000	450	+20	−25	−50	80	−20 +5	−5 +40	40
		1500	450	+20	−25	−50	80	−15 +5	−0 +40	40
	50 ±5	500	300	+15	−25	−50	75	−15 +5	−0 +40	35
		2000	400	+15	−25	−50	75	−10 +5	−0 +60	35
	60 ±5	500	200	+15	−20	−50	75	−15 +5	−0 +40	35
		2500	350	+15	−20	−50	75	−10 +5	−0 +50	35
	70 ±5	500	150	+15	−20	−50	75	−15 +5	−0 +35	35
		2500	300	+15	−20	−50	75	−10 +5	−0 +40	35
	80 ±5	500	100	+15	−20	−50	75	−15 +5	−0 +30	35
		2000	125	+15	−20	−50	75	−10 +5	−0 +30	35
	90 ±5	500	50	+10	−20	−50	75	−10 +5	−0 +25	35
		1500	100	+10	−20	−50	75	−10 +5	−0 +25	35
							22 Hr at 158 F			
Oil Resistant Compounds Medium Volume Swell	30 ±5	500	300	+20	−15	−40	80	−10 +15	+50 +120	50
		2000	500	+20	−15	−40	60	−10 +15	+50 +140	45
	40 ±5	500	300	+20	−15	−40	65	−10 +15	+50 +120	45
		2500	500	+15	−15	−40	60	−10 +15	+50 +140	40
	50 ±5	500	300	+20	−15	−40	60	−10 +15	+40 +100	40
		3500	500	+15	−15	−40	50	−10 +15	+40 +150	40
	60 ±5	500	300	+20	−15	−40	50	−10 +15	+40 +100	45
		3500	400	+15	−15	−40	50	−5 +10	+40 +150	45
	70 ±5	500	200	+15	−15	−40	50	−5 +10	+30 +100	50
		2500	300	+15	−15	−40	50	−5 +10	+30 +120	50
	80 ±5	500	100	+15	−15	−40	45	−5 +10	+20 +80	50
		2000	150	+15	−15	−40	45	−5 +10	+20 +80	50
	90 ±5	500	50	+10	−15	−40	50	−5 +10	+10 +70	50
		2000	150	+10	−15	−40	45	−5 +10	+10 +70	50

(Adapted from ASTM Specs)

Typical Normal Temperature Compounds

Additional Requirements, to be Specified Specially									
oad at 20% eforma-ion, Psi	Resili-ence at 20% Defor-mation, Min %	Max Change, Immersion in Petroleum Base Oil, Aniline Point 124 C, 70 Hr at 212 F				Max Change, Immersion in Petroleum Base Oil, Aniline Point 70 C, 70 Hr at 212 F			
		Tens. St., %	Ult. Elong., %	Volume, % (Limits)	Duro-meter Hard. (Limits)	Tens. St., %	Ult. Elong., %	Volume, % (Limits)	Duro-meter Hard. (Limits)
—	—	—	—	—	—	—	—	—	—
70 ±10	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
00 ±15	80	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
40 ±20	75	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
95 ±30	70	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
00 ±70	60	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
75 ±100	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—
—	—	−20	−50	—	−5 +10	−20	−50	—	−5 +10
—	—	−20	−50	—	−5 +10	−20	−50	—	−5 +10
—	—	−30	−50	—	−5 +10	−20	−50	—	−5 +10
—	—	−30	−50	—	−5 +10	−30	−50	—	−5 +10
—	—	−30	−50	—	−5 +10	−30	−50	—	−5 +10
—	—	−30	−50	—	−5 +10	−30	−50	—	−5 +10
—	—	−25	−50	−15 +5	−5 +15	−40	−50	−0 +30	−15 +5
—	—	−30	−50	−10 +5	−5 +10	−45	−50	−0 +35	−15 +5
—	—	−25	−45	−10 +5	−5 +10	−45	−50	−0 +25	−15 +5
—	—	−30	−45	−10 +5	−5 +10	−50	−55	−0 +30	−15 +5
—	—	−20	−40	−10 +5	−5 +10	−35	−40	−0 +25	−10 +5
—	—	−20	−40	−10 +5	−5 +10	−40	−50	−0 +30	−10 +5
—	—	−20	−40	−10 +5	−5 +10	−35	−35	−0 +25	−10 +5
—	—	−20	−40	−10 +5	−5 +10	−40	−40	−0 +30	−10 +5
—	—	−20	−40	−10 +5	−5 +10	−35	−35	−0 +20	−10 +5
—	—	−20	−40	−10 +5	−5 +10	−35	−35	−0 +20	−10 +5
—	—	−20	−40	−10 +5	−5 +10	−35	−35	−0 +20	−10 +5
—	—	−20	−40	−10 +5	−5 +10	−35	−35	−0 +20	−10 +5
—	—	−20	−30	—	±10	−80	−60	—	—
—	70	−30	−30	—	±10	−80	−60	—	—
—	—	−20	−30	—	±10	−75	−55	—	—
—	70	−30	−30	—	±10	−80	−55	—	—
—	—	−30	−30	—	±10	−70	−55	—	—
—	70	−40	−30	—	±10	−80	−55	—	—
—	—	−30	−30	—	±10	−65	−55	—	—
—	65	−40	−30	—	±10	−80	−55	—	—
—	—	−15	−30	—	−5 +10	−65	−50	—	—
—	60	−20	−30	—	−5 +10	−70	−50	—	—
—	—	−15	−30	—	−5 +10	−45	−30	—	—
—	—	−15	−30	—	−5 +10	−45	−30	—	—
—	—	−15	−30	—	±5	−40	−20	—	—
—	—	−15	−30	—	±5	−40	−20	—	—

Since no appreciable part of the stress-strain curve is straight, modulus of elasticity has a unique definition. It is the stress required to produce a given strain. Stress that produces a 300% strain is the 300% modulus. This stress-strain ratio is different at every other strain.

Tear Resistance — Tear resistance tests consist of pulling in tension razor-nicked crescent specimens, razor-nicked crescent specimens with tab ends, or unnicked 90 deg angle specimens. Tear resistance is measured by the breaking load per average thickness. Results are comparative and have no service correlation significance. Results between different tests do not necessarily correlate.

Abrasion Resistance—Abrasion resistance is purely relative. In tests, abrasive material on revolving wheels or disks is brought in contact with a material sample. From the weight loss and specific gravity, the volume loss is calculated.

Impact Resistance — Impact tests are usually the standard Izod or Charpy tests used with plastics and electrical insulating materials. The relative susceptibility to fracture by shock is supposedly found. In the Izod test, a specimen held as a cantilever beam is struck at a fixed distance from the edge of the clamp by a pendulum. The energy in the moving pendulum when the specimen breaks is the test value. The Charpy test is similar except that the specimen is a simple beam broken by a blow between the supports. Results by the two methods cannot be compared directly. Correlation of either to actual service is extremely difficult.

Resilience — Resilience is often measured by mechanical oscillograph. An unbalanced horizontal lever is linked to a pen which traces a curve on a rotating cylinder. The lever rests on a specimen. The lever is loaded and released to compress or shear load the specimen. The resulting vibratory motion is traced on the moving cylinder. Resilience is calculated by measuring the amplitude loss in successive vibrations.

Other resilience tests use ball or pendulum rebounds from the sample as criteria. The results from all these tests do not necessarily agree, but they give the same order of magnitude.

Adhesion—Adhesion tests may be used for manufacturing control and, with slight modifications, for comparison of production parts. In one procedure, a cylinder of rubber with metal plates attached to both ends is

Table 3—Physical Property Ranges of

Type	Basic Requirements								Max Change, Immersion in Petroleum Base Oil, Aniline Point 255 F, 70 Hr at 300 F			
	Durometer Hard.	Tens. St., Min, Psi	Ult. Elong., Min, %	Max Change With Heat Aging			Comp. Set, Max, % 70 Hr at 300 F	Comp. Set, Max, % 70 Hr at 300 F				
				Durometer Hard. (Limits)	Tens. St., %	Ult. Elong., %			Tens. St., %	Ult. Elong., %	Durometer Hard. (Limits)	Volume, % (Limits)
				70 Hr at 450 F								
Max Resistance to High and Low Temperature[1]	50 ±5	500	200	+20	−30	−40	—	50[2]	−20	−20	−15	0 +20
	60 ±5	400	100	+20	−30	−50	—	40[2]	−20	−20	−15	0 +20
	70 ±5	400	75	+15	−25	−40	—	40[2]	−20	−20	−15	0 +20
	80 ±5	500	50	+15	−25	−40	—	40[2]	−20	−20	−15	0 +20
				70 Hr at 350 F								
Outstanding Resistance to Dry Heat and Oils at High Temperature	40 ±5	800	225	0 +15	−30	−50	60	—	−20	−30	−5 +10	−3 +5
	50 ±5	1200	225	0 +10	−30	−50	60	—	−20	−30	−5 +10	−3 +5
	60 ±5	1500	200	0 +10	−30	−50	60	—	−20	−30	−5 +10	−3 +5
	70 ±5	1500	175	0 +10	−30	−50	60	—	−20	−30	−5 +10	−3 +5
	80 ±5	1500	125	0 +10	−30	−50	70	—	−20	−30	−5 +10	−3 +5

NOTES: [1] *Not brittle after 5 hr at −65 F.*
[2] *Lower values possible with sacrifice in tensile strength and elongation.*
[3] *These values met with sacrifice of tensile strength and elongation.*

(Adapted from ASTM)

used. Studs are attached to the metal plates and the specimen is pulled in a test machine. The stress at failure is a measure of adhesion. In another method, a strip of rubber is bonded to one metal plate. The tension required to strip it off is a measure of adhesion.

Resistance to Aging—Oven aging tests are used to estimate resistance to natural aging. Deterioration is measured by drop in tensile strength and elongation. Heat is used merely to accelerate deterioration. There is no direct correlation between test results and service life. Results can only be compared with results given by other compounds with known service characteristics. For natural rubber, oven tests give misleading results in many cases. A test using oxygen under high pressure is used instead. This indicates susceptibility to oxidation, the chief cause of natural aging in many cases.

Oil aging tests are used in estimating comparative ability to withstand liquids. In some cases, no direct correlation can be made between tests and service performance. Samples are exposed to standard oils or fuels or to the liquid met in service. Temperatures approximate service conditions. Deterioration is measured by changes in weight or volume, tensile strength, ultimate elongation and appearance. The behavior of various compounds varies widely, and consultation with suppliers and actual service tests are necessary for service in contact with oils, solvents or chemicals.

Weather Resistance — Weather resistance is indicated by exposure to sunlight or ultraviolet lamps. In one set of tests, strips under stress are exposed to weather and sun. Specimens can be stretched or looped to induce stress. Resistance is gaged by the length of time before surface checking and cracks appear, and/or by decrease in tensile strength and elongation.

Staining — Staining qualities are tested by putting samples of rubber and the surface in question in contact for specific time intervals at elevated temperature. Paint, lacquer, enamel and other finishes may be discolored by contact with some rubber parts, and high finish metals might tarnish. Stains may occur on surface areas directly in contact with the rubber, or they may migrate and appear in adjacent areas.

Low Temperature Properties — These characteristics are evaluated by tests agreed upon by supplier and user. Service requirements must be studied carefully to make sure the right test is specified.

At low temperatures, two changes can occur in rubber. Natural, neoprene and butyl crystallize, natural most rapidly at —4 F and neoprene at 32 F. This change takes time and the part is stiffened but not necessarily embrittled. The second change does not depend on time, only on temperature. As the part gets colder, hysteresis increases and the modulus increases. Finally the part becomes brittle to mechanical shock.

Tests measure the brittle point and stiffness. A motor driven arm strikes

Typical Heat Resistant Compounds

Additional Requirements, to be Specified Specially									
Max Change, Immersion in Petroleum Base Oil, Aniline Point 158 F, 70 Hr at 300 F				Max Change, Immersion in Hydrocarbon Test Fluid (Sulfur and Chlorine Constituents) 70 Hr at 300 F				Max Change, Immersion in water 168 Hr at 158 F	
Tens. St., %	Ult. Elong., %	Durometer Hard. (Limits)	Volume, % (Limits)	Tens. St., %	Ult. Elong., %	Durometer Hard. (Limits)	Volume, % (Limits)	Durometer Hard.	Volume, %
—	—	−30	+60	—	—	—	—	−10[3]	+10[3]
—	—	−35	+60	—	—	—	—	−10	+10
—	—	−40	+60	—	—	—	—	−10	+10
—	—	−45	+60	—	—	—	—	−10	+10
−30	−20	−10	0 +20	−10	−10	−5 +10	−3 +5	—	—
−30	−20	−10	0 +20	−10	−10	−5 +10	−3 +5	—	—
−30	−20	−10	0 +20	−10	−10	−5 +10	−3 +5	—	—
−30	−20	−10	0 +20	−10	−10	−5 +10	−3 +5	—	—
−30	−20	−10	0 +20	−10	−10	−5 +10	−3 +5	—	—

Service under actual working conditions is the only reliable guide in choosing a compound.

First of all, users often pick the wrong property as being most important to success in a given application. Many users order conveyor belt covers with maximum tensile strength, for example. Actually, a cover with lower strength would be just as good or maybe even better, since a sacrifice in strength would often allow better resistance to oil, heat and certain kinds of abrasion.

Many engineers forget that specified properties are measured under closely controlled conditions. Properties may be quite different in an environment only slightly different from the test standard. Tensile strength at 212 F may be as little as 10% what it is at 82 F. Stress for a given deflection may be 3 times as great in rapid loading as in standard slow-speed tests. Thus, under service conditions, a part may not have anything like the properties the designer intended to specify.

Even under closely controlled conditions test qualities and service qualities cannot be made identical. For example, the abrasion resistance measured on a given piece of equipment can not be accurate when applied to both the service life of a shoe heel and a sand blast hose.

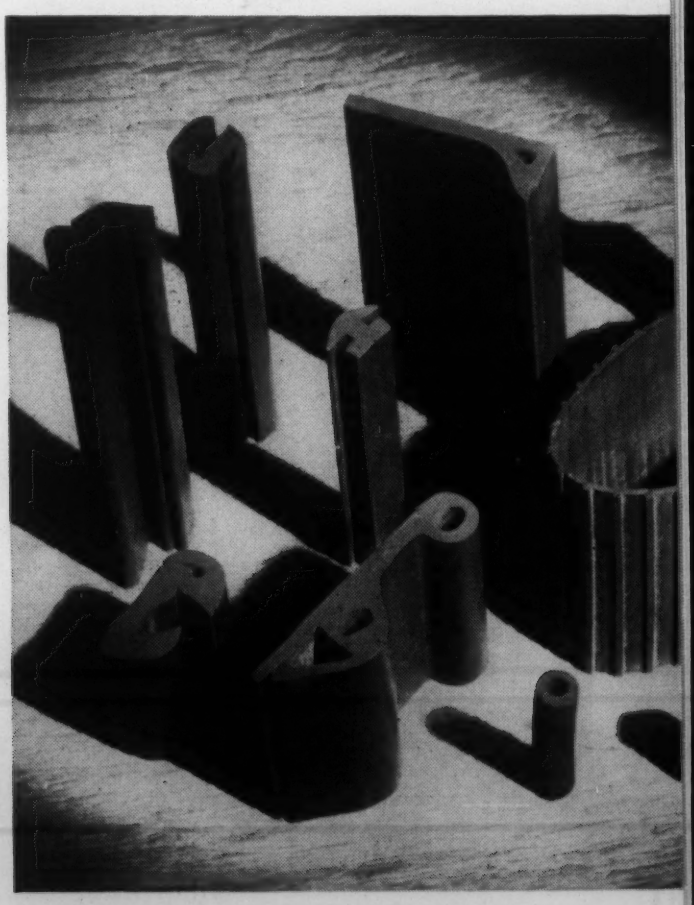
Another peculiarity of rubber is a small cantilevered sample at decreasing temperatures to find the brittle temperature, measured when the samples break completely on impact. Other tests evaluate stiffness increase at low temperatures by measuring torsional modulus or Young's modulus.

In addition to all of the above, there are many other tests and properties, of course. Properties like moisture absorption, flame resistance and electrical resistivity can be specified. Standard tests are available for some of these, but in many cases tests must be agreed upon by suppliers and users.

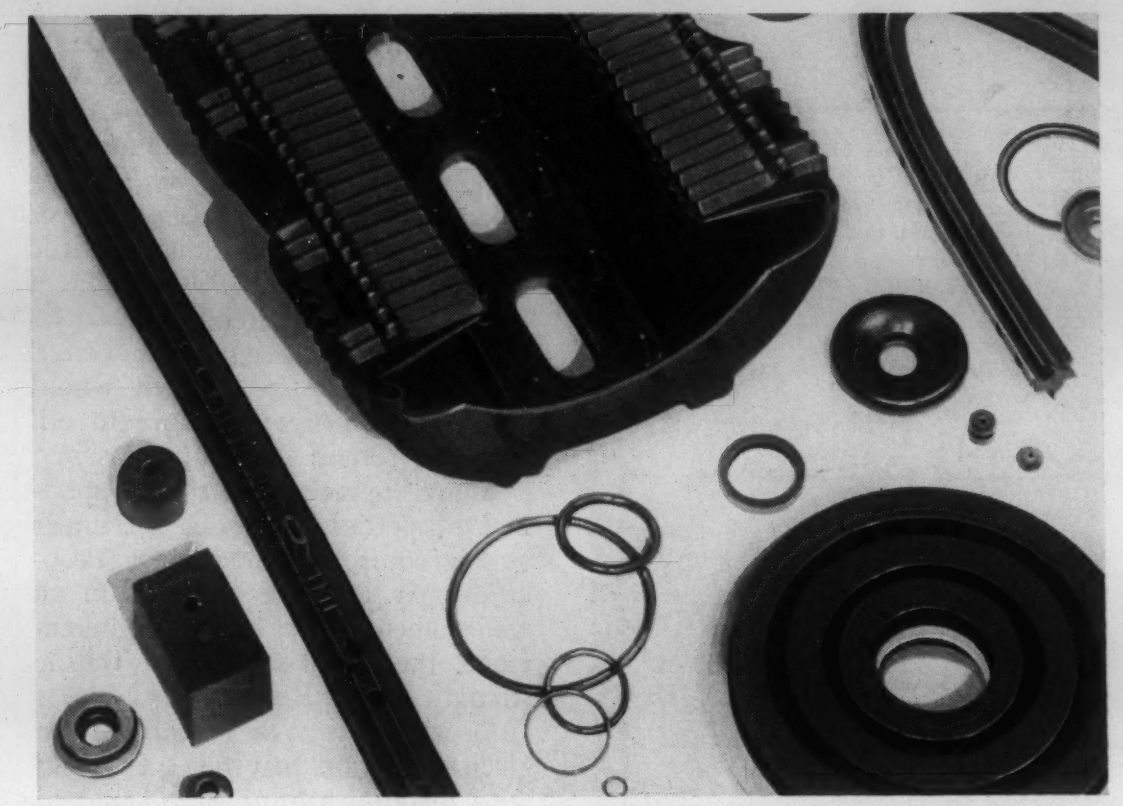
Specification Limitations

While the classification system given above is informative, it has definite limitations. A specifying engineer must know: 1) what properties he really needs; and 2) what properties he is actually asking for in a specification. Too much faith should not be placed in specifications based completely on laboratory tests.

Cellular rubber is used for the massage cushion on a hand electric vibrator (top) and a clutch pedal seal (bottom).



Pictured above are typical extruded rubber shapes.



These rubber parts range from a large packing weighing 4 lb, used to protect wheel bearings on trains, to a small O-ring weighing 0.001 lb, used in a high pressure application.

that its properties are not permanent, and change as the material ages and deteriorates. Heat, oils, chemicals, sunlight, weather and aging tend to break down rubber. Specific compounds, however, can be designed to have very high resistance to one or several of these factors.

Another pitfall is the unwarranted assumption that specifications describe a compound completely. Actually, although two compounds which satisfy a given specification are similar, there is no guarantee that an application filled successfully by one can be covered equally well by the other.

Laboratory tests will not necessarily give a true measure of the performance of a compound in actual service. When intelligently correlated with service data, however, tests are a valuable tool for predicting performance.

Table 4—Typical Hard Rubber Compounds

Principal Characteristics or Uses	Tens. Str., Psi	Color	Elong., %	Sp. Gr.	Rock. Hard.	Durometer Hard.	Izod Imp. Str. ft. lb./in. Notch	Flexural Str., Psi	Heat Distort. Temp., F	Dielectric Str. 60 Cycles, v/mil.	Power Factor 1 Megacycle % (at 1 Kc)	Dielectric Constant 1 Megacycle (at 1 Kc)	Surface Resistance Megohms at 74 F 86% R. H.	Water Absorp. 48 hrs. at Room Temp.
MOLDED PARTS														
General Purposes	8300	Black	4.00	1.21	108–76	81–87	0.48	12500	142	435	0.8	3.00	4.8×10^5	0.08
General Purposes	7900	Black	4.00	1.21	107–91	81–87	0.45	11340	145	496	0.7	2.95	over 10^8	0.06
General Purposes	4500	Black	3.40	1.28	129–79	78–84	0.45	7125	134	344	1.2	3.80	over 10^8	0.14
General Purposes	2000	Black	2.00	1.54	103–27	76–82	0.27	2818	Low	377	2.8	4.95	5.08×10^5	0.30
High Heat Resistance	6750	Red-Brown	2.60	1.65	83–60	85–92	0.35	8675	283	393	1.2	4.10	5.32×10^3	0.06
High Arc Resistance, Heat and Wear Resistance	4000	Red-Brown	1.00	1.95	65–41	87–95	0.32	8400	300	600	2.5	4.80	Arc Resistance 248	0.06
Arc, Heat, Wear Resistance High Dielectric Quality	5800	Red-Brown	2.60	1.71	82–55	86–92	0.38	9060	246	371	1.2	4.60	4.46×10^4	0.10
High Heat Resistance, Chemical Resistance	7170	Black	2.70	1.24	115–85	84–90	0.41	11300	275	400	1.6*	3.50*	2.0×10^8	0.12
Heat Resistance, Low Moisture Absorption	5400	Black	1.80	1.80	82–54	84–92	0.34	10000	295	420	1.8	4.10	8.02×10^4	0.04
SHEETS														
General Purposes	9300	Black	5.00	1.20	112–79	80–86	0.48	16600	159	487	0.5	2.95	2.23×10^7	0.06
General Purposes	8300	Black	4.10	1.21	108–76	80–86	0.48	12625	142	435	0.8	3.00	4.81×10^5	0.08
General Purposes	6750	Black	4.20	1.21	126–70	80–86	0.44	12600	134	474	0.6	3.05	1.24×10^4	0.08
High Elongation (Semi-Hard)	2550	Black	33.00	1.17	—	50–60	0.51	—	Low	437	1.3	3.00	2.66×10^4	0.22
High Heat Resistance	7400	Black	1.20	1.43	86–60	86–92	0.53	9640	221	613	0.6	3.25	over 10^8	0.15
High Heat Resistance, Chemical Resistance	7170	Black	2.70	1.24	115–85	84–90	0.41	11300	275	400	1.6*	3.50*	2.0×10^8	0.12
Strength, Flow Resistance High Dielectric Quality	7450	Yellow-Brown	5.30	1.27	112–80	80–86	0.50	14950	150	415	0.6	3.70	7.98×10^4	0.08
RODS AND TUBES														
General Purposes	9700	Black	5.00	1.21	107–70	80–86	0.48	11375	163	524	0.5	2.90	over 10^8	0.06
General Purposes	7500	Black	3.00	1.21	116–82	80–86	0.47	11130	146	462	0.9	2.80	over 10^8	0.10
High Elongation	3600	Black	16.00	1.15	—	65–75	0.48	—	Low	512	1.4	3.15	over 10^8	0.12
High Heat Resistance, Chemical Resistance	7170	Black	2.70	1.24	115–85	84–90	0.41	11300	275	400	1.6*	3.50*	2.0×10^8	0.12
Strength, Flow Resistance High Dielectric Quality	6500	Yellow-Brown	3.80	1.27	112–80	80–86	0.52	9060	217	374	0.9	3.60	6.73×10^4	0.07

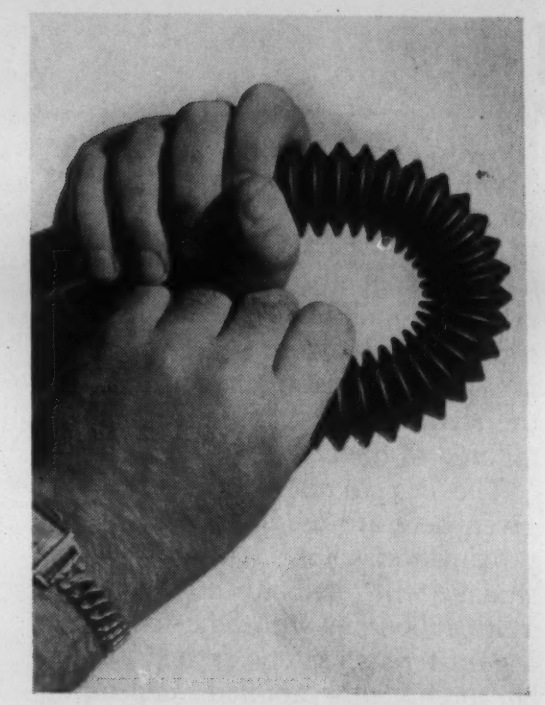
Hard Rubber in general has a Coefficient of Linear Expansion of 0.00004/deg. F.

(American Hard Rubber Co.)

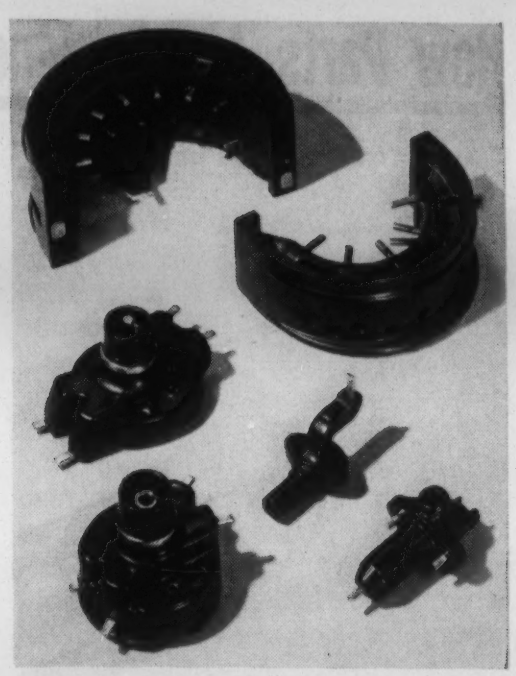
Specifying Hard Rubber

Hard rubber is not specified by the systems used for softer rubbers. A variety of standard grades are made and one of these almost invariably fits a new application.

Testing methods for hard rubber (25% or more sulfur) are different because the material is more like a rigid plastic than an elastomer. Tensile strength, elongation, flexural strength and impact resistance are found by testing methods usually used with rigid plastics. Hardness may be determined by the Rockwell test. Cold flow is gaged by the thickness change of a sample under a given load for a given time at a given temperature. Softening temperature, dielectric strength, power factor and surface and volume resistivity are tested by comparatively conventional means and are important specification properties.



Electrically conducting rubber hose used on hospital anesthetic equipment grounds static charges to prevent sparks that might cause explosions.



Some electrical parts molded of hard rubber. Magneto part (top) is wear resistant, strong at 300 F, has high arc resistance and high dielectric strength. The part is molded with 17 inserts.

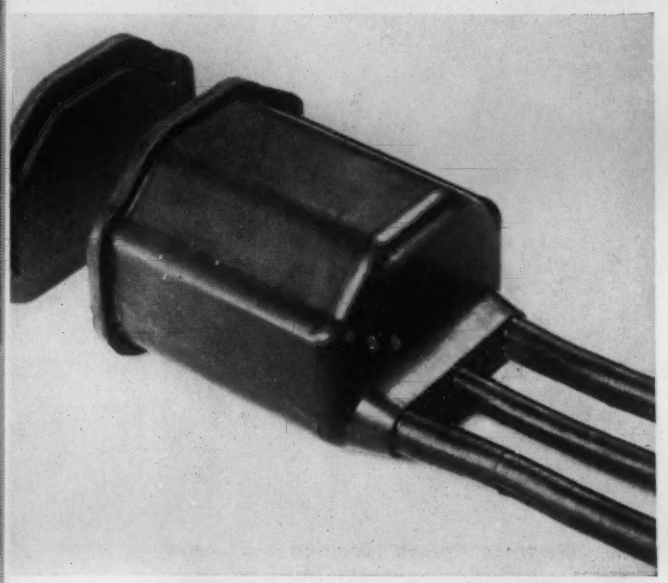
Table 5—Physical Property Ranges, Typical Cellular Compounds

	Basic Requirements					Additional Requirements, Specified Specially			
	Load for 25% Defl., 50 Sq In. Area, Lbs	Pressure for 25% Defl., Psi	Change of Load-Defl. or Indentation Value with Heat, %	Max Comp. Set, 50% Defl., 22 Hr at 158 F, %	Max Vol. Change, Immersion in Oil Aniline Point 160 F, 22 Hr at 158 F, %	Max Change From Original, 25% Defl. After 5 Hr at −40 F, %	Max Wt Change After Immersion in Water 22 Hr at Room Temp., %	Max Comp. Set, 50% Defl., 22 Hr at 158 F, %	Max Comp. Set, 250,000 Flexing Cycles at 60 per Min, %
			22 Hr at 212 F						
LATEX FOAM									
Cored	9½± 3½	—	±20	20	—	75	—	—	20[1]
	118½±11½	—	±20	20	—	75	—	—	40[2]
Uncored	72½±12½	—	±20	20	—	75	—	—	—
			7 Days at 158 F						
SPONGE									
Non-Oil Resistant	—	1 ±1½	±20	15	—	25	—	—	—
	—	20½±3½	±20	15	—	25	—	—	—
Oil Resistant, Low Swell	—	1 ±1½	±20	40	−25 +10	50	—	—	—
	—	20½±3½	±20	40	−25 +10	50	—	—	—
Oil Resistant, Medium Swell	—	1 ±1½	±20	50	+10 +60	50	—	25	—
	—	20½±3½	±20	50	+10 +60	50	—	25	—
CLOSED CELL									
Non-Oil Resistant	—	3½±1½	—	—	—	—	10	—	—
	—	20½±3½	—	—	—	—	10	—	—
Oil Resistant, Low Swell	—	3½±2	—	—	—	—	10	—	—
	—	20½±3½	—	—	—	—	10	—	—
Oil Resistant, Medium Swell	—	3½±1½	—	—	—	—	10	—	—
	—	20½±3½	—	—	—	—	10	—	—

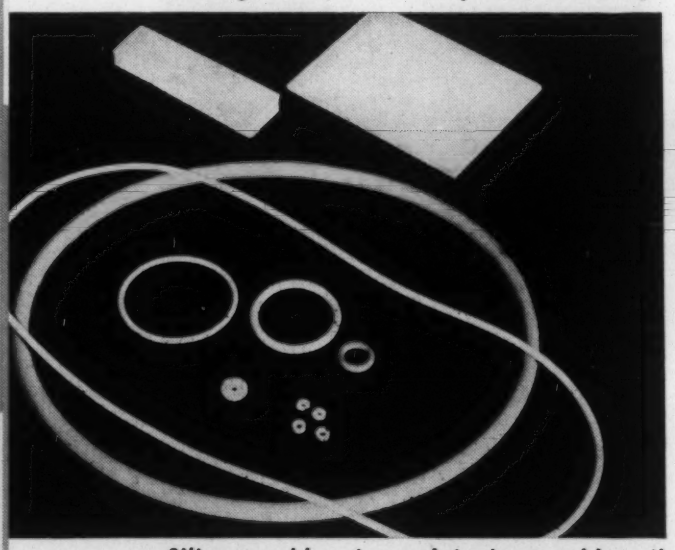
[1] 50% deflection.
[2] 25% deflection.

(Adapted from ASTM Specs.)

How Parts Are Designed



Rubber is used in many electrical applications because of water imperviousness, insulating value, moldability and durability.



Silicone rubber is used in heat-stable, oil resistant seals in the aircraft, automotive and electrical industries. Flat sheets of dense and sponged rubber are used as gasketing materials.

Hycar rubber is molded in long-wearing printing plates. It resists the aniline inks.

Parts must be designed specifically for rubber. A common mistake is to change a part from another material without changing design. When rubber is indicated, a complete design reappraisal is in order. Supporting parts, operating conditions and the shape of the part itself must be tailored to the new material.

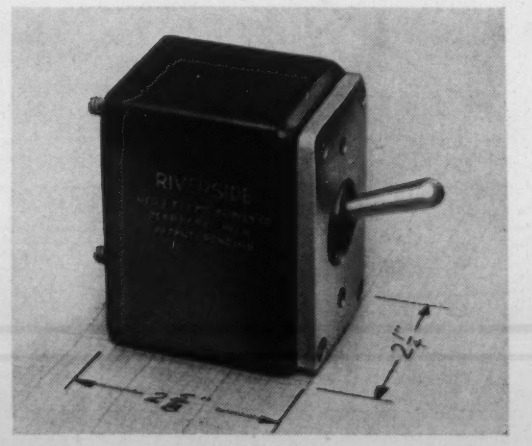
The design rules and conventions given here are used for the first approximation. Tests and production studies will lead to modifications. With rubber, as with other engineering materials, safety factors should be intelligently applied, depending on the application. Design cooperation between users and manufacturers is very important with any part.

Shapes and Forms

A ridge, called flash, forms around a molded part at the parting line between the mold halves. Standard practice is to put the parting line on the product where it makes for the best mold design and operation. On compression molded parts, for example, parting lines should be at the largest diameter. If flash is not permissible at a particular point, this fact should be shown on the part drawing. Allowable limits on flash should also be given.

The simplest part is usually best. Simple geometric shapes are usually easier and cheaper to make than more complicated shapes. Beads and undercuts should be eliminated unless absolutely necessary. Fragile edges should be avoided, and at least 1/16-in. thicknesses should be specified for all flanges. Inserts of cloth or metal should be avoided if possible. Radii at edges and corners should be at least 1/32 in. for strength, good appearance and breakage resistance. To reduce curing time to get uniform cure, sections should be as light and uniform as possible.

With flexible rubber, undercut parts can sometimes be molded in one piece. This is usually only possible with relatively soft compounds, and with 80 to 90 hard rubber, undercuts should be avoided. Hollow hard rubber parts can be molded by a special blown process, however. A slight draft is necessary on 90 to 95 hard rubber. While softer compounds do not require draft, it does facilitate removal from the mold and should be incorporated wherever possible.



Heavy duty ordnance type switch is enclosed in rubber. It is dust-tight, functions from -65 to 165 F, and withstands shock, vibration and salt spray.

Tolerances

Tolerances depend on how parts are made. Flash thickness varies and must be taken into consideration. Typical tolerances are shown in accompanying tables. These tables are merely for comparison and estimation, since manufacturers recommendations differ. In any case however, wide tolerances mean low costs. Liberal tolerances are quite satisfactory for the softer solid rubbers and cellular rubbers because parts can often be stretched or squeezed into place.

Metal-Rubber Bonding

Metal-to-rubber bonds must be designed carefully. With correctly prepared surfaces, adhesion values of 250 psi can be expected with low-carbon steels and certain other metal alloys. Large fillets should be used at rubber-metal joints on stressed parts. Although bond strength is usually greater than the tear strength of the rubber, there should be no flexing at the bond. Drawings should indicate whether excess rubber must be removed from the metal.

Tension

Rubber is not usually used in tension because of low tear resistance. Better design ordinarily uses rubber in shear. Where it is used in tension low stresses, large deflections, or both are usual. Suggested maximum working stresses are 50 psi for hardnesses below 50, 60 psi for 50 to 65 and 75 psi above 65 hardness.

Compression

In compression springs, rubber

Table 6—Tolerances[1] on Solid Parts

Molded Parts[2]

Linear Dimen. Range, In.	Tol. Not Affected by Flash Thickness	Tol. Across Flash Plane	Dia. Range	Eccentricity Limit, Total Indicator Runout
0–½	±0.005	±0.015[3]	0–2½	0.02
½–1	±0.005	±1/64	2½–5	1/32
1–2	±0.5%	±1/32	5–10	1/16
2–3	±0.5%	±3/64	—	—

[1] *All dimensions in in., unless otherwise noted.*
[2] *Products over 6 in. long not covered.*
[3] *With compression molding. With transfer and injection molding, ±0.010.*

Lathe Cut Parts

Inside Diameters, in.		Outside Diameters, in.			Thickness (Cut), in.	
Tol. Mandrel Cure	Tol. Pan Cure	Tol. Ground Finish	Tol. Unground		Range	Tol.
			<1½	>1½		
+0.000–0.010	±0.031	±0.010	±0.031	±0.062	1/16–3/16	±0.015
					¼–⅜	±0.025
					½–1	±0.031

Extruded Parts

Tubing						Special Shapes	
Length, in.		Inside Dia., in.		Outside Dia., in.		Cross Section Dimen., in.	
Range	Tol.	Range	Tol.	Range	Tol.	Range	Tol.
0–1½	±1/64	0–½	±0.008	0–½	±1/64	0–¼	±1/64
1½–10	±3/64	½–1	±1/64	½–1	±1/32	¼–½	±1/32
10–40	±1/16	1–3	±1/32	1–2	±3/64	½–1	±3/64
40–60	±¼	—	—	2–4	±1/16	1–2	±1/16

Die Cut Parts

Thickness, in.	Tol.
¼–1/32	±0.008
1/16–⅛	±0.016
5/32–⅜	±0.031
½ and over	±0.047

must have some lateral freedom. Resistance to change of volume is great.

Compression sandwiches have many practical applications. When rubber is compressed between two plates, it tends to spread out from the center. This may be resisted completely at the plates by bonding the metal to the rubber, or almost completely with roughened surfaces. Resistance can be reduced to almost nothing by lubrication. If lateral movement is restricted, indicated stiffness is greater. Stiffness is also affected by part shape—rectangular and circular columns of the same cross sectional area show different deflections under the same load. There are no perfect formulas for stress and deflection in rubber sandwiches. Charts and graphs have been worked out by producers to solve practical problems, however. These are used with factors that fit different sandwich shapes. Durometter hardness, stress, deflection, part shape and part dimensions are considered in these charts. Results are only approximate (±15 to 30% for deflections, according to one producer), but good enough for preliminary design. While data are only available for sandwiches with flat, parallel top and bottom surfaces, other shapes can be estimated by making approximations.

Compression sandwiches must be kept within stability limits. A sandwich that is too high and narrow may buckle. Ordinarily, a piece should not be higher that it is wide. Under light loading with small deflections, however, applications with thicknesses twice widths have been successful.

Shear

Since rubber deflects more under a given load in shear than in compression, rubber-metal shear sandwiches and bushings are widely used in mounting and suspension assemblies. Double sandwiches, consisting of two identical rectangular bodies of rubber bonded between two outer metal plates and a central metal plate, are often used for static shear mountings. Annular sandwiches are used in rotational shear. Another variation is a coaxial bushing sandwich in rotational shear.

Stress calculations are more difficult in shear than in compression. Shape, importance of creep, hazards in case of failure and length of service expected must be considered in setting stress limits. Liberal radii at edges and corners are recommended to avoid stress concentration and in-

Table 7—Suggested Tolerances for Cellular Rubber Parts

	Thickness, In.			Length and Width, In.		
	Dimension	Tolerance		Dimension	Tolerance	
		Plus	Minus		Plus	Minus
SPONGE RUBBER						
Sheet and Strip	1/8 and under	1/64	1/64	6 and under	1/16	1/16
	Over 1/8 to 1/2, incl.	1/32	1/32	Over 6 to 18, incl	1/8	1/8
	Over 1/2	3/64	3/64	Over 18	0.5%	0.5%
Molded or Special Shapes	1/4 and under	1/32	1/32	1/4 and under	1/32	1/32
	Over 1/4 to 3, incl	1/16	1/16	Over 1/4 to 3, incl	1/16	1/16
				Over 3 to 18, incl	1/8	1/8
				Over 18	0.5%	0.5%
EXPANDED RUBBER						
Sheet and Strip	1/8 to 1/2, incl	1/16	1/16	6 and under	1/4	1/4
	Over 1/2	3/32	3/32	6 to 12, incl	3/8	3/8
				Over 12	3%	3%
Molded or Special Shapes	1/8 to 1/2, incl	1/16	1/16	6 and under	1/4	1/4
	1/2 to 1 1/2, incl	3/32	3/32	6 to 12, incl	3/8	3/8
	1 1/2 to 3, incl	1/8	1/8	Over 12	3%	3%
LATEX FOAM						
Cored	0 to 3, incl	1/8	1/16	0 to 6, incl	3/16	1/16
	3 to 5, incl	3/16	1/8	6 to 12, incl	1/8	1/8
	5 and over	1/4	3/16	12 to 24, incl	1/2	1/4
				24 to 36, incl	5/8	3/8
				36 to 48, incl	3/4	1/2
				48 to 60, incl	7/8	5/8
				60 to 72, incl	1	3/4
				72 and over	1 1/8	7/8
Uncored	Up to and including 1/2	1/16	1/16	0 to 6, incl	5/16	1/16
	From 1/2 to 1, incl	1/8	1/16	6 to 12, incl	1/2	1/8
	Over 1	1/8	1/8	12 to 24, incl	11/16	1/4
				24 to 36, incl	7/8	3/8
				36 to 48, incl	1 1/16	1/2
				48 to 60, incl	1 1/4	5/8
				60 to 72, incl	1 3/8	3/4
				72 and over	1 1/2	7/8

(Adapted from ASTM Specs)

crease service life. In linear static shear, allowable stresses for continuous loading vary from below 50 psi for durometer 30 rubber to 100 psi for durometer 80. Limits for occasional loading are given as 75 psi for durometer 30 up to 160 psi for durometer 80. In linear shear, edge effects keep average allowable stress lower than in rotative shear. In rotational shear, continuous limits are 75 and 160 psi for 30 and 80 durometer rubbers respectively. For occasional loading, limits are 120 and 240 psi for 30 and 80 durometers.

In calculating size and deflection of shear parts, a number of approximate formulas have been worked out by producers. Starting with the shear modulus of the material, the fixed dimensions and the load, the deflection, bond stress and rubber volume can be approximated.

Vibration

In spring parts and vibration dampers, dynamic properties must be considered. The design of a spring part begins with extensive calculations. These can be found in books on vibration. Where greater accuracy is needed, experiments with actual parts are necessary.

The dynamic modulus of elasticity of rubber is higher than the corresponding static modulus. The difference may be 20% or more. At low temperatures, resilience may become very low. The ratio of dynamic to static modulus increases with decrease of resilience. This ratio may be as high as 2 to 1.

Heat and resilience are closely related. Flexure generates heat in rubber, which may affect properties. Resilience increases with higher temperatures. While rubber resiliency is essentially independent of vibrational frequency, this fact may be obscured by internal friction effects. Greater amplitudes generate more friction and more heat. If this is allowed to raise the part temperature, resiliency will increase.

Vibration lowers the life of rubber. Parts subject to continual flexing develop small surface cracks which eventually cause failure. Parts containing fabric fail either at the rubber-fabric junction, in the rubber itself, or in both rubber and fabric.

Creep

Additional deformation with elapsed time under load is defined as creep. Rubber shows creep at any stress level and temperature. Creep can be minimized by special com-

pounding, full vulcanization, low working stress and avoidance of unnecessarily high service temperatures, however.

Creep is usually expressed as percent of original deformation. This is reasonably constant over wide stress ranges for a given compound and time. On the average, compression creep is about 20% less than shear creep. Tension creep, on the other hand, is about 30% greater than shear creep.

Creep is rapid at first, then decreases steadily. If the time period is very long or the stress very high, a point may be reached where creep increases again rapidly to failure. Such stresses are, of course, well above practical working limits.

Creep increases with hardness. Lowest creep is found in 35 to 40 hard, high quality, well vulcanized natural rubber compounds. These creep about 15% on original deformation in 60 days, and 25% in 3 years. Natural rubber 60 hard compounds can be prepared to creep 20 and 40% respectively. Compounds not designed for continuous load carrying may creep several times as much.

When stresses are released, the part gradually moves back towards its original shape. This recovery depends on the compound. The residual or unrecoverable portion of creep is called permanent set. Intermittent loads cause less creep than continuous stress. Continuously vibratory loading, on the other hand, accelerates creep.

Temperature Effects

Too much importance is often placed on room temperature properties. Another error is to consider only the thermal behavior of natural rubber, while the part is actually made of synthetic.

Compounded synthetics vary more in resiliency with temperature than natural. Butyl, for example, increases 80 to 100% at 212 F; natural rubber is only 5% greater at 212 F. Neoprene, about equal to natural in resiliency at room temperature, is higher at elevated temperatures. The same holds true for GR-S and Buna-N.

In hysteresis, neoprene, Buna-N and butyl decreases and GR-S and natural increase, as temperature goes up to 212 F.

Elevated temperatures age natural rubber more than synthetics. In oxygen and air, synthetics show marked superiority. In open steam, synthetics are comparable to natural rubber. Generally, synthetics tend to stiffen and shorten with age, eventually becoming more brittle. Natural tends to harden at first, finally becoming very soft.

The problems at low temperature are loss of flexibility and brittleness. Without special compounding, minimum temperatures for good flexibility are: silicone —110 F; GR-S, —50 F; natural, —65 F; butyl, —25 F; neoprene, —25 F; Buna-N, —25 F. These limits can be lowered with special compounding to about —80 F for GR-S and natural; —60 F for neoprene and butyl; and —60 F for Buna-N.

Linear and volumetric coefficients of thermal expansions are important for bonding rubber to metals. At or-

Table 8—Suggested Tolerances for Hard Rubber Parts

MOLDED PARTS

Normal Dimensions ±0.006 in. per in.

Across Parting Line ±0.006 in. per in. plus 0.020 in.

	Outside Diameter, In.	Tolerance, In.
EXTRUDED ROD AND TUBE		
Ground or Polished		
	Up to 3/8 incl	+0.001 to −0.001
	3/8 to 3/4 incl	+0.002 to −0.001
	3/4 to 1 incl	+0.002 to −0.002
	1 to 1 1/4 incl	+0.003 to −0.002
	1 1/4 to 1 1/2 incl	+0.003 to −0.003
	1 1/2 to 2 incl	+0.004 to −0.004
	2 to 3 incl	+0.005 to −0.005
	3 to 3 1/2 incl	+0.005 to −0.005
	3 1/2 to 4 incl	+0.007 to −0.007
	4 to 4 1/2 incl	+0.008 to −0.008
	4 1/2 to 5 incl	+0.015 to −0.015
Rough		
	Up to 1/8 incl	+0.015 to +0.029
	1/8 to 1/4 incl	+0.020 to +0.033
	1/4 to 3/8 incl	+0.025 to +0.036
	3/8 to 1/2 incl	+0.025 to +0.040
	1/2 to 5/8 incl	+0.025 to +0.044
	5/8 to 3/4 incl	+0.025 to +0.048
	3/4 to 1 incl	+0.025 to +0.055
	1 to 1 1/4 incl	+0.025 to +0.062
	1 1/4 to 1 1/2 incl	+0.030 to +0.070
	1 1/2 to 1 3/4 incl	+0.030 to +0.077
	1 3/4 to 2 incl	+0.035 to +0.085
	2 to 2 1/2 incl	+0.040 to +0.090
	2 1/2 to 3 incl	+0.045 to +0.095
	2 to 3 1/2 incl	+0.050 to +0.100
	3 1/2 to 4 1/4 incl	+0.060 to +0.125
	4 1/2 to 5 incl	+0.073 to +0.135
Rough, Ground or Polished		
	Inside Diameter, In.	
	1/16 to 1/4 incl	0.005
	1/4 to 1/2 incl	0.006
	1/2 to 3/4 incl	0.009
	3/4 to 1 incl	0.012
	1 to 1 1/4 incl	0.015
	1 1/4 to 1 1/2 incl	0.018
	1 1/2 to 2 incl	0.024
SHEET		
	Thickness, In.	
	0.005	−0.000 to +0.002
	0.005 to 0.010 incl	−0.000 to +0.003
	0.010 to 1/64 incl	−0.000 to +0.004
	1/64 to 1/32 incl	−0.000 to +0.005
	1/32 to 1/16 incl	−0.000 to +0.008
	1/16 to 1/8 incl	−0.000 to +0.011
	1/8 to 1/4 incl	−0.000 to +0.014
	1/4 to 3/8 incl	−0.000 to +0.016
	3/8 to 1/2 incl	−0.000 to +0.019
	1/2 to 5/8 incl	−0.000 to +0.021
	5/8 to 3/4 incl	−0.000 to +0.026
	3/4 to 7/8 incl	−0.000 to +0.030
	7/8 to 1 incl	−0.000 to +0.032

(Adapted from data from American Hard Rubber Co.)

Table 9—Adhesive Bond Strengths

"Good" indicates an adhesive bond tear strength equal to, or exceeding, that of the rubber or synthetic.
"Fair" indicates an adhesive bond tear strength less than that of the rubber or synthetic but sufficient for some applications.
"Poor" indicates bond strength considered satisfactory only for applications where a low degree of adhesion is required.

	Natural Rubber	GR-S	Neoprene	Nitrile Rubber	Butyl Rubber	Silicone
Black Iron	Good	Good	Good	Good	Fair	Good
Steel	Good	Good	Good	Good	Fair	Good
Aluminum	Good	Good	Good	Good	Fair	Good
Stainless Steel	Good	Good	Good	Good	Fair	Good
Lead	Poor	Poor	Poor	Poor	Poor	—
Copper	Fair	Fair	Fair	Poor	Poor	—
Dow Metal	Good	Good	Good	Fair	Fair	—
Zinc	Good	Good	Good	Good	Fair	—
Brass (70/30)	Good	Good	Good	Fair	Fair	Good
Brass Plate	Good	Good	Fair	Fair	Fair	—
**Carbon	Fair	Fair	Fair	Fair	Fair	—

** The constant "good" rating of silicone is due to low tear and tensile strength of the polymer itself.*
*** Bond failures in this group occur when the insert (carbon) breaks.*

(Acushnet Process Co.)

dinary temperatures, soft natural has a volume coefficient per degree F of 0.037%. Hard natural rubber runs 0.01 to 0.013%. Synthetics lie in about the same range.

Thermal conductivity of rubbers is low. Values in Btu/hr/ sq ft/ in./deg F are about 0.99 for unvulcanized natural, 1.34 for neoprene, 1.82 for GR-S and 1.82 for Buna-N. Compounding for higher hardness may increase these values up to 30% because of the greater conductivity of the added materials. In cellular rubber, thermal conductivity decreases with density. A hard cellular GR-S of 4.5 lb per cu ft density has a conductivity of 0.21.

Electrical Properties

The electrical properties most commonly involved in service are resistivity, dielectric strength, dielectric constant and power factor. They can be varied widely to develop specific qualities for various uses.

Although rubber is usually an electrical insulator, special compounds have low resistance to electric currents. Any rubber can be made conductive, but the carbon black added for conductivity increases hardness. Materials as soft as those obtained by conventional methods cannot be made. Conductive products can be molded, calendered or extruded.

Compounded rubbers range in resistivity from 10^{15} to 1 ohm-cm. Sheet filament and wire are available in 1-5 ohm-cm forms. Resistivities from 10^{6} ohm-cm are available in sheet, wire and molded products. Resistivity tolerances of $\pm 10\%$ or even $\pm 7\%$ can be held in the 1-5 ohm-cm products, as long as close tolerances are not demanded on part thickness. In the 10-10^{6} ohm-cm class, tolerances are wider. Resistivity of conductive rubber increases as the part is put in tension or compression, and does return to its original value immediately after stress is relieved. As a general rule, conductive rubbers are not soft, and the higher the conductivity, the harder the rubber. A resistivity of 20 ohm-cm would be expected to go with 75 hardness. A less conductive compound, with a resistivity of 30,000 ohm-cm, might have a hardness of 50.

The dielectric constant of pure natural rubber is usually given as 2.4 to 2.5. Most compounds have a considerably higher value.

In pure rubber and high grade insulation, power factor is a very small fraction, frequently of the order of magnitude of 0.005. As rubber becomes more conductive, the power factor approaches 1.

Color

The reinforcing ability of the various carbon blacks account for the fact that high quality industrial parts are nearly always black. Preference should be given to black compounds unless there is a compelling reason for some other color. If color is desired, other physical properties must usually be sacrificed.

Cellular Parts

Cellular parts can be molded directly so that the finished product has an overall skin. This skin is a smooth surface formed by contact with the mold. Particularly where complicated shapes are involved, completely molded parts may be expensive.

Die cut shapes are used more frequently in both open and closed cell materials. These have skin on top and bottom, with honeycomb edges. Where abrasion resistance or water and gas absorption are problems, a solid rubber layer can be put over the natural skin. Good resistance to water absorption can be obtained by specifying closed cellular rubber. Another variation is sheet with skin on only one side. This is made by splitting regular sheet in half. Sheet and strip are regularly made up to 1 in. thick. By cementing standard sheets together, thicker parts result.

Acknowledgments

We gratefully acknowledge the assistance we have received from personnel and publications of the following organizations:

Acushnet Process Co.
Allis Rubber Corp.
American Hard Rubber Co.
American Society for Testing Materials
Boston Woven Hose & Rubber Co.
Chicago Rawhide Mfg. Co.
Connecticut Hard Rubber Co.
Davidson Rubber Co.
Dow Corning Corp.
E. I. du Pont de Nemours & Co., Inc.
Essex Rubber Co.
Firestone Industrial Products Co.
General Electric Co., Chemical Div.
B. F. Goodrich Chemical Co.
Goodyear Tire & Rubber Co., Inc.
Greene, Tweed & Co.
Lavelle Rubber Co.
Linear Inc.
Parker Appliance Co.
Riverside Mfg. and Electrical Supply Co.
Roth Rubber Co.
Rubatex Div., Great American Industries, Inc.
Sponge Rubber Products Co.
Stalwart Rubber Co.
Thiokol Chemical Corp.
United States Rubber Co.
Westinghouse Electric Co.

PICTURE CREDITS: Acadia Synthetic Products Div., Western Felt Works, American Hard Rubber Co., Connecticut Hard Rubber Co., Davidson Rubber Co., Firestone Industrial Products Co., B. F. Goodrich Chemical Co., Goodyear Tire & Rubber Co., Inc., Parker Appliance Co., Riverside Mfg. & Electrical Supply Co., Roth Rubber Co., Sponge Rubber Products Co., Stalwart Rubber Co., Thiokol Chemical Corp., U. S. Rubber Co.

Reprints of this (and other) Manuals are available at 25¢ each until supply is exhausted. See page 219 for complete list of available Manuals. Write for quotations on quantities of 100 or more. Address requests to Reader Service Dept., MATERIALS & METHODS, 330 W. 42nd St., New York 36, N. Y.

MATERIALS & METHODS
July • 1953
Number 256

Materials Engineering File Facts

Materials Data Sheet

Manganese Steels

The effect of manganese in increasing the tensile srrength and improving the tensile-yield strength ratio is employed to advantage in the 1300 series. These steels have good response to heat treatment in heavy sections.

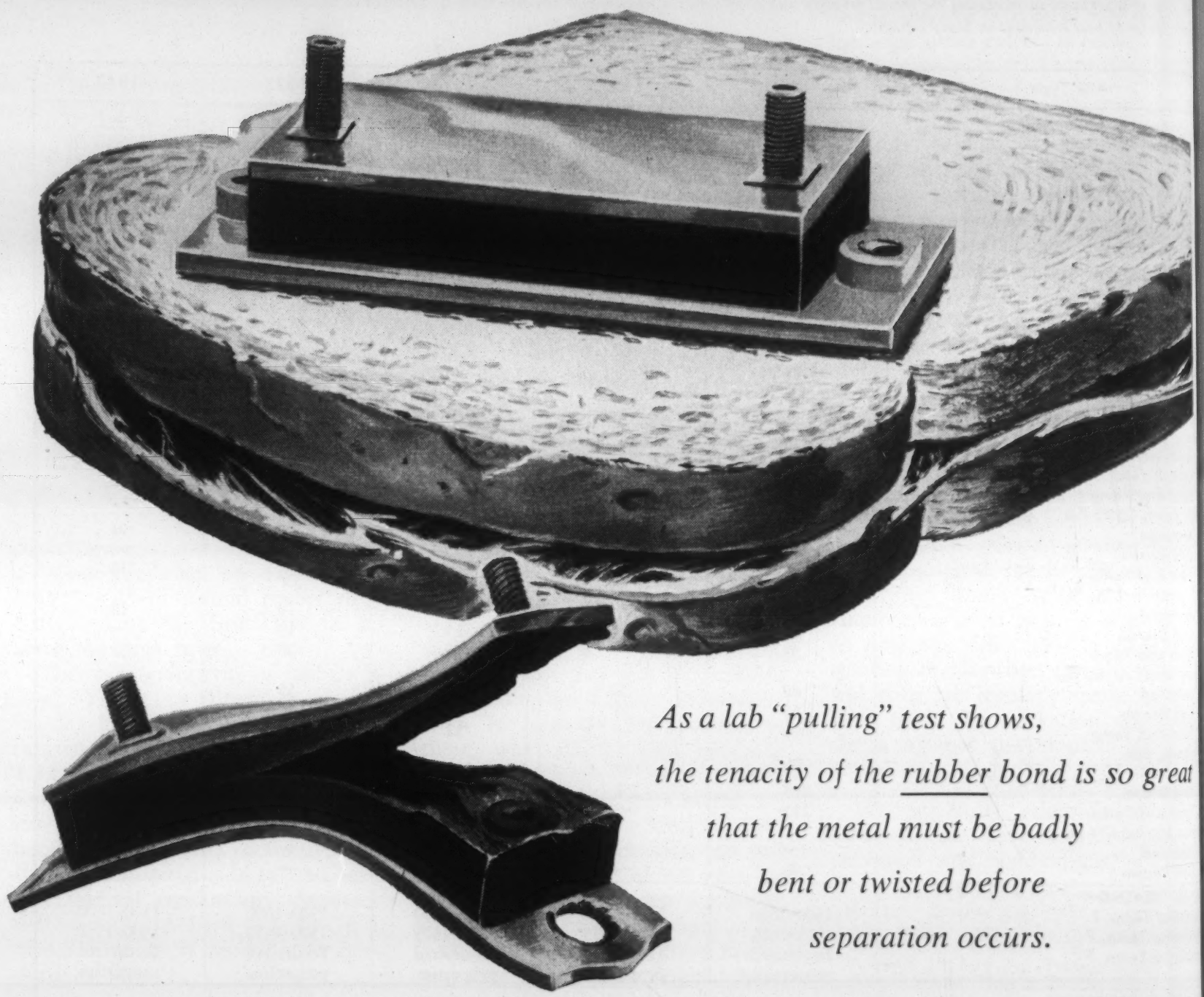
Typical Properties

AISI Type	1320	1321	1330	1335	1340
COMPOSITION	C 0.18/0.23 Mn 1.60/1.90 Si 0.20/0.35 P (max) 0.040 S (max) 0.040	C 0.17/0.22 Mn 1.80/2.10 Si 0.20/0.35 P (max) 0.050 S (max) 0.050	C 0.28/0.33 Mn 1.60/1.90 Si 0.20/0.35 P (max) 0.040 S (max) 0.040	C 0.33/0.38 Mn 1.60/1.90 Si 0.20/0.35 P (max) 0.040 S (max) 0.040	C 0.38/0.43 Mn 1.60/1.90 Si 0.20/0.35 P (max) 0.040 S (max) 0.040
PHYSICAL PROPERTIES					
Density, Lb/Cu In.	0.283	0.283	0.283	0.283	0.283
Thermal Cond, Btu/Hr/Sq Ft/F @ 212 F	27	27	27	27	27
Coeff of Exp per F:					
68–1200 F	7.9×10^{-6}	7.9×10^{-6}	7.9×10^{-6}	7.9×10^{-6}	7.9×10^{-6}
Spec Ht, Btu/Lb/F	0.10–0.11	0.10–0.11	0.10–0.11	0.10–0.11	0.10–0.11
Elect Res, Microhm-Cm @ 68 F	17	17	17	17	17
Magnetic Properties	Magnetic	Magnetic	Magnetic	Magnetic	Magnetic
MECHANICAL PROPERTIES[1]					
Mod of Elasticity, in Tension, Psi	$29–30 \times 10^6$	$29–30 \times 10^6$	$29–30 \times 10^6$	$29–30 \times 10^6$	$29–30 \times 10^6$
Tensile Str, 1000 Psi:					
Annealed	84	90	97	104	110
Cold Drawn	102	107	113	119	—
Hard and Temp	100[2]	—	122[3]	126[4]	137[4]
Yield Point, 1000 Psi:					
Annealed	72	80	83	90	94
Cold Drawn	80	87	93	100	—
Hard and Temp	73.5	—	100	105	118
Elongation in 2 In., %:					
Annealed	24	22	21	19.5	18
Cold Drawn	20	18	15	14	—
Hard and Temp	28	—	19	20.5	19
Reduction of Area, %:					
Annealed	60	58	57	55	54
Cold Drawn	57	55	50	47	—
Hard and Temp	65	—	52	59	55
Hardness, Bhn:					
Annealed	179	187	197	212	223
Cold Drawn	207	212	235	248	—
Hard and Temp	217	—	248	262	285
Impact Str, Izod Ft-Lb:					
Annealed	—	—	—	—	52
Cold Drawn	80	—	—	—	56
THERMAL TREATMENT					
Annealing Temp, F	1500–1600	1500–1600	1500–1600	1500–1600	1500–1600
Hardening Temp, F	1575–1625	1575–1625	1500–1575	1500–1550	1500–1550
Tempering Temp, F	To desired properties	To desired properties	To desired properties	To desired properties	To desired properties
FABRICATING PROPERTIES					
Machinability Index (B1112 Steel = 100)					
Annealed or Cold Drawn	65	63	62	62	59
Weldability	In common with most alloying elements which lower M_s and M_f temperatures, manganese increases the crack sensitivity of welded joints, particularly when this sensitivity is associated with higher carbon contents. Appropriate control of welding practice must accordingly be employed with these steels.				
CORROSION RESISTANCE	These steels rust when brought into contact with moisture and air at rates similar to those of the carbon steels. If salts are present, the corrosion rate is increased. These steels are attacked readily by acids but are resistant to alkalies at ordinary temperatures.				
AVAILABLE FORMS	Billets, hot rolled bars, cold finished bars, forgings.				
USES	Automotive, farm implement and miscellaneous industrial applications, including axles, drive shafts, propeller shafts, bolts, studs, gears, tie rods, etc.				

NOTES: [1] *Mechanical properties determined on 1-in. round bars.*
[2] *Pseudo-carburized at 1700 F for 8 hr, oil quenched, tempered at 300 F, reheated at 1475 F.*
[3] *Water-quenched from 1525 F, tempered at 1000 F.*
[4] *Oil-quenched from 1525 F, tempered at 1000 F.*

Prepared with the assistance of Bliss & Laughlin, Inc.

This is a rubber-and-metal sandwich...



As a lab "pulling" test shows, the tenacity of the rubber bond is so great that the metal must be badly bent or twisted before separation occurs.

Note that the D-nuts were actually torn out by the testing machine! These rubber-to-metal sandwiches, in a variety of designs and sizes, are made for the original equipment manufacturer at United States Rubber Company's great plant at Fort Wayne. They are just one example of the many different products available to you at this centrally located plant.

Just as important is the great "U.S." laboratory at Fort Wayne, where scientists and engineers are at work developing new ways to help your product operate more efficiently. Maybe "U.S." already has the answer to a problem of yours. In any event, "U.S." engineers will be happy to tackle it. They know their job, and they have all the help that modern science can give. Get in touch with one of the 25 strategically located District Sales Offices or write to address below.

U.S.RUBBER
SERVING THROUGH SCIENCE

"U.S." Research perfects it
"U.S." Production builds it
U. S. Industry depends on it

UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.

Hose • Belting • Expansion Joints • Rubber-to-metal Products • Oil Field Specialties • Plastic Pipe and Fittings • Grinding Wheels • Packings • Tapes
Molded and Extruded Rubber and Plastic Products • Protective Linings and Coatings • Conductive Rubber • Adhesives • Roll Coverings • Mats and Matting

Properties of Electrical Insulating Materials

	Glass-Bonded Mica (Molding Grade)	Steatite	Mica-Filled Phenolic	Alkyd (Polyester Molding Compound Mineral-Filled)	Melamine (Asbestos Filled)
Dimensional Precision and Stability	A	C	B	B	C
Heat Distortion, F	650–700	1800	230–350	350–400	265
Thermal Expansion/C	10×10^{-6}	7×10^{-6}	19×10^{-6}	35×10^{-6}	$20–45 \times 10^{-6}$
Power Factor 10^6 Cycles/Sec	0.0015–0.0018	0.0025	0.005–0.013	0.014–0.018	0.041–0.050
Dielectric Constant 10^6 Cycles/Sec	7.4–9.2	5.8–6.3	4.2–5.2	4.6–4.9	6.1–6.7
Loss Factor 10^6 Cycles/Sec	0.013–0.014	0.014–0.016	0.021–0.065	0.064–0.088	0.25–0.33
Dielectric Strength ⅛-In. Thickness, Volts/Mil 25 C (Step-by-Step) 100 C (Step-by-Step)	 400–500 400–500	 240 240	 250–390 —	 325–335 508–525+	 320 —
ARC Resistance ASTM Seconds	250–300	500	Tracks	190+	120–140
Mold Shrinkage, In./In.	Nil	—	0.0005–0.005	0.004–0.007	0.005–0.007
Tensile Strength, Psi	5000–7000	9000	5000–7000	3000–4000	5500–7000
Compressive Strength, Psi	23,000–35,000	80,000	15,000–25,000	18,000–20,000	30,000
Flexural Strength, Psi	12,000–15,000	20,000	8000–12,000	8000–10,000	9000–11,000
Modulus of Elasticity, Psi	$7.2–11 \times 10^6$	12×10^6	$3.0–5.0 \times 10^6$	2.5×10^6	1.6×10^6
Impact Strength, Izod Ft-Lb/In. of Notch	0.70–1.85	1.90	0.30–0.38	0.30–0.35	0.28–0.40
Water Absorption, 24 Hr ⅛-In. Thickness, %	Nil	0–0.05	0.01–0.10	0.5–0.8	0.08–0.14
Specific Gravity	2.6–3.8	2.7	1.75–1.92	2.18–2.22	1.70–2.00

(Continued on page 109)

A blind rivet that may open your eyes

There may be a message for you in these pictures, even if you don't use rivets.

For maybe you have a product that isn't performing the way you want it to. And maybe your problem is to find the right metal.

The makers of "pop" rivets had just such a problem.

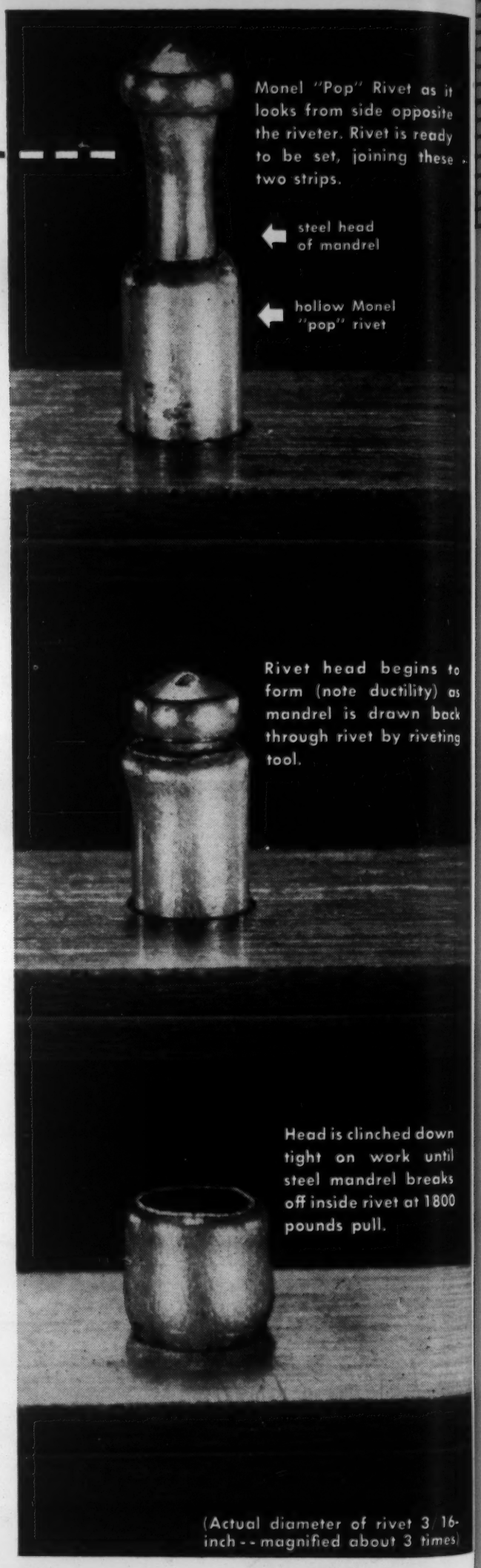
Here they'd come up with a wonderful idea for a blind fastening. The "pop" rivet lets you rivet tightly in blind corners and other confined places where you can only get to work on one side. And it's easy to use and does the job inexpensively. Still, the metal used wasn't quite right for every job . . .

First, they needed a metal that is strong enough to make a tight joint, even in thin gauge sheet metal. Yet the metal had to be ductile enough to form a tight-holding head when riveted. And it had to be able to resist corrosion by most acids, alkalies and many other corrosives.

After trying other metals, they found Monel® provided their answer. And the characteristics and the economy of Monel "pop" rivets make them a possible replacement for many non-blind fastenings as well, wherever a hollow Monel rivet can be used for N.P.A.-approved applications.

Perhaps this metal problem of the rivet makers brings one of your own to mind. And perhaps your solution, too, lies in Monel, or another metal in the Inco Nickel Alloy family. The quickest, easiest way to find out is to write us. All our problem-solving services are yours for the asking. The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.

"Pop" Rivets, long known as "Tucker Blind Rivets" in Great Britain, are now being produced in this country by J. C. RHODES & COMPANY, branch of UNITED SHOE MACHINERY CORPORATION, New Bedford, Mass.



Inco Nickel Alloys

INCO TRADE MARK

MONEL® • "R"® MONEL • "K"® MONEL • "KR"® MONEL • "S"® MONEL • INCONEL® • INCONEL "X"® • INCONEL "W"® • INCOLOY® • NIMONIC® ALLOYS • NICKEL • LOW CARBON NICKEL • DURANICKEL®

NUMBER 257 (continued)

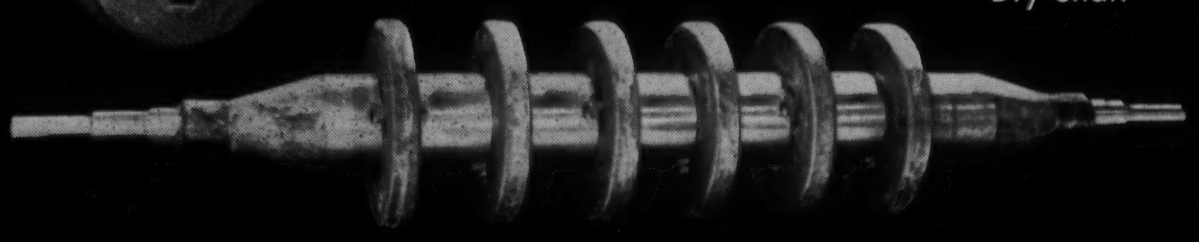
Properties of Electrical Insulating Materials

	General Purpose Phenolic (Wood-Flour Filler)	Teflon	Kel-F	Polystyrene	Electrical Glass	Porcelain
Dimensional Precision and Stability	C	C	B	B	B	C
Heat Distortion, F	260–340	266 (66 psi)	160 (66 psi)	200–210	925–1679	2200
Thermal Expansion/C	30–45 x 10^{-6}	99 x 10^{-6}	45 x 10^{-6}	78 x 10^{-6}	3.3–13.0 x 10^{-6}	5 x 10^{-6}
Power Factor 10^6 Cycles/Sec	0.03–0.07	0.002	0.0082	0.0001–0.0002	0.0006–0.009	0.008–0.01
Dielectric Constant 10^6 Cycles/Sec	4.0–7.0	2.0–2.05	2.43	2.40–2.42	4.0–7.2	6.5
Loss Factor 10^6 Cycles/Sec	0.12–0.49	0.0004	0.019	0.0002–0.0005	0.0024–0.065	0.05–0.07
Dielectric Strength ⅛-In. Thickness, Volts/Mil						
25 C (Step-by-Step)	100–375	430	390	600	500	200
100 C (Step-by-Step)	—	—	—	—	500	200
ARC Resistance ASTM Seconds	Tracks	700	360	70–130	500	500
Mold Shrinkage, In./In.	0.004–0.009	0.005–0.010	0.005–0.010	0.02–0.05	—	—
Tensile Strength, Psi	6500–8500	1500–2500	5700	8500–9500	8000–14,000	4500
Compressive Strength, Psi	22,700–36,000	1700	32,000–88,000	12,000–13,500	60,000–175,000	40,000
Flexural Strength, Psi	8500–12,000	2000	8200	12,000–13,000	11,000–16,000	11,000–18,000
Modulus of Elasticity, Psi	0.8–1.2 x 10^6	0.058 x 10^6	0.226 x 10^6	0.017–0.47 x 10^6	7.1–11.5 x 10^6	10 x 10^6
Impact Strength, Izod Ft-Lb/In. of Notch	0.24–0.60	4.0	3.62	0.30–0.45	—	0.70–1.25
Water Absorption, 24 Hr ⅛-In. Thickness, %	0.3–1.0	Nil	Nil	0.04–0.06	Nil	0–0.5
Specific Gravity	1.32–1.55	2.1–2.3	2.1	1.05–1.07	2.13–3.18	2.35–2.45

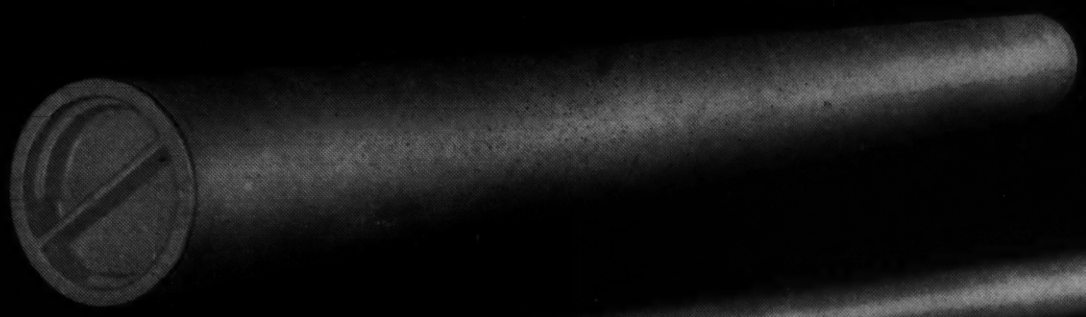
NOTE: Dimensional-Precision-Stability: "A" rating indicates no shrinkage during and after molding and excellent dimensional and age stability under all exposure conditions.
"B" rating indicates appreciable molding shrinkage but good stability under exposure conditions.
"C" rating indicates shrinkage on molding and during aging, firing or dimensional change under exposure conditions.

Courtesy Mycalex Corp. of America

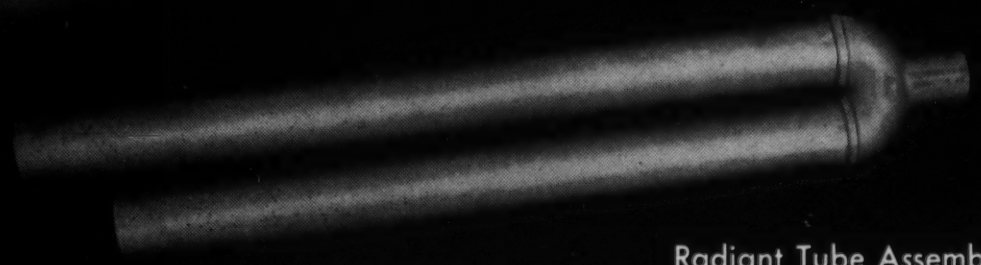
Composite Roll Heads



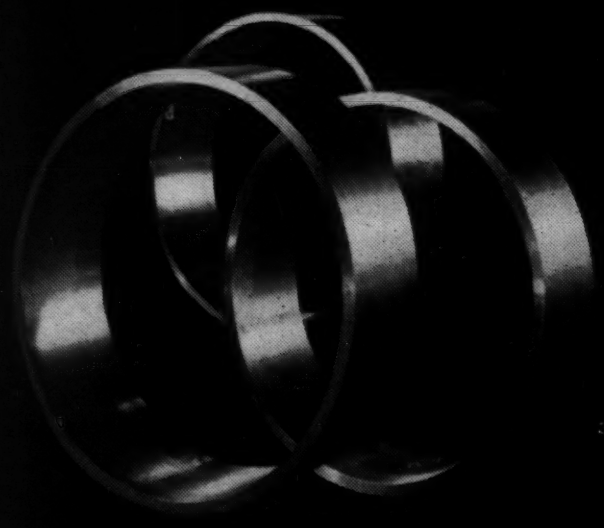
Dry Shaft



Annealing Retort
Length, 18'; Diameter, 13"



Radiant Tube Assembly



Jet Rings

Center Post Fixture with
Centrifugally Cast Post

Check the advantages of CENTRIFUGAL CASTINGS IN THERMALLOY*

Now you can obtain cylindrical shapes, such as those illustrated here, centrifugally cast in high heat-resistant THERMALLOY. The advantages of centrifugal casting, as opposed to static casting, include: *improved uniformity of wall thickness; finer grain structure and higher density; lower finishing and machining costs... resulting from improved dimensional control.*

We are equipped to produce horizontal sand and permanent mold castings in sizes from 3½" to 20" O. D. up to 96" in length; in vertical permanent mold from 20" to 34" O. D.

Write for the new Centrifugal Casting Bulletin, or call your nearest Electro-Alloys Sales Office. Electro-Alloys Division, 2086 Taylor Street, Elyria, Ohio.

*Reg. U. S. Pat. Off.

AMERICAN Brake Shoe COMPANY

ELECTRO-ALLOYS DIVISION
ELYRIA, OHIO

New Materials and Equipment

New Developments in Silicones

Several important developments in silicones were announced recently by *Dow Corning Corp.*, Midland, Mich. Among the most significant of these developments are a rigid, nonflammable silicone foam; new modified silicone resins for protective coatings; and a magnet wire enamel.

Silicone Foam

Two of the new resins, XR-543 and XR-544, can be expanded to form uniform, unicellular structures weighing 8 to 24 lb/cu ft. It is expected they may answer a long-standing need in the aircraft industry for lightweight, nonflammable material that will retain its compressive strength at high temperatures. A major advantage compared to some other heat-resistant materials is its ability to be foamed in place.

Silicone foam structures have been exposed to temperatures of 700 F for over 20 hr with little structural or dimensional change, according to Dow Corning. Tests indicate that the foam will retain its physical properties for long periods of time at temperatures in the range of 500 F. Half-inch sections can be brought to a red heat over a direct flame without softening or showing significant decomposition. Its thermal insulating quality reduces this to only a slight warmth on the opposite face.

The XR-544 resin is recommended for applications where both high strength at elevated temperatures and extreme temperature stability are required. The XR-543 modification is suggested where the temperature resistance is still necessary, but high compressive strength is not essential.

Likely forms for applications are "sandwich" constructions, reinforcements foamed in place, or parts machined from blocks of the foam.

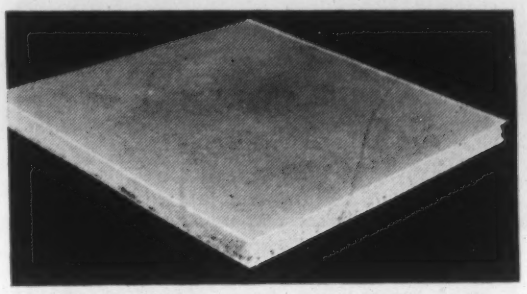
Protective Coatings

Extension of the range of applications for silicone-based protective coatings is claimed as a result of the development of two new resins. One of them, Dow Corning 805, is said to retain good flexibility and adhesion even after long aging at elevated temperatures. At 600 to 1000 F, finishes made with this resin are claimed to have twice the thermal life of paints made with the earlier resins, and 10 to 30 times the life of high temperature organic finishes. Applications for these heat resistant finishes include paints for hot stacks, mufflers, exhaust manifolds and industrial pipe lines; coatings for space heaters, incinerators and domestic appliances; and color films for lamps and bulbs.

The other new resin is an air drying modified silicone-alkyd resin known as Dow Corning XR-807. Both clear and pigmented coatings made with it are said to have good weather resistance, color retention and resistance to chalking. It is compatible with alkyd and phenolic varnishes and amine resins. It can also be combined with nitrocellulose to give greater flexibility, adhesion and cold-check resistance.

Magnet Wire Enamel

A silicone wire enamel, known as Dow Corning 1360, is claimed to have about the same life expectancy at 390 F as the best organic magnet wire enamels have at their top operating temperatures of 220 F.



A major advantage of this silicone is its ability to be foamed in place.

In flexibility and scrape abrasion resistance, it compares favorably with those of the better organic wire enamels; and it has good resistance to a variety of solvents, oil and salt water. Motors wound with magnet wire coated with the new enamel are said to be still in good condition after more than 1500 hr of operation at 437 F.

The developers say that Class H insulating materials now available will give maximum life and reliability to electric machines where space is not a limiting factor. But in fractional or miniature Class H motors or in electronic devices they think life and reliability can be greatly increased with the new magnet wire enamel.

Another new silicone resin, Dow Corning XR-928, has been developed especially as a coating for surfaces subject to voltage stresses. It increases surface resistivity and prevents the formation of moisture film, thus minimizing leakage currents. A major potential application is the treatment of porcelain insulators on transmission and distribution systems. The resin is adaptable to air-drying or low temperature baking.

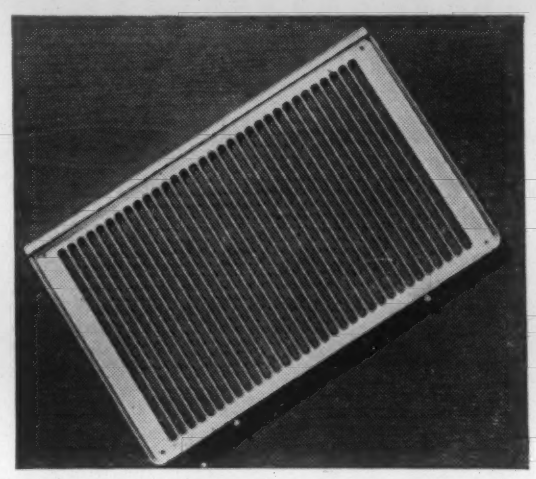
Blackening Compound for Stainless Steels

A new ferrous metal blackening compound known as Dulite 3-0 Black, has been introduced by the *Du-Lite Chemical Corp.*, Middletown, Conn. Particularly effective for stainless steels, this compound will produce a non-fading black finish quickly and easily on malleable iron, etc., as well as on stainless without the need for any special equipment.

Operating temperatures required for processing with Dulite 3-0 are exceptionally low, the maximum involved being 240 F. It is supplied in dry salts form, mixed as needed, eliminating the danger of carboys and liquid chemicals.

New Materials and Equipment continued

Magnesium-Type Aluminum Sheet Alloy



A new magnesium type aluminum sheet alloy is being used for louvered refrigerator shelves.

Development of K155, a new magnesium-type aluminum sheet alloy for general metalworking requirements, has been announced by *Kaiser Aluminum & Chemical Sales, Inc.*, 1924 Broadway, Oakland 12, Calif. The alloy has been used for more than two years in the production-line stamping of louvered refrigerator shelves, and also in such products as light reflectors, meat trays and utensils. K155 is said to have the same general mechanical properties as the manganese-type alloy, 3S, but it is expected to replace it in many applications because of advantages deriving from its magnesium content.

As compared with 3S, K155 forms as easily, but appears to stand up a little better in actual service. It has very good corrosion resistance. The new alloy is also well suited for taking anodized finishes as it shows less tendency toward structural streaking and has a clearer, lighter color after processing that is free of the yellowish-grey tinge of 3S or the brownish tinge of 52S. For architectural applications it will closely match the color of anodized 63S extrusions.

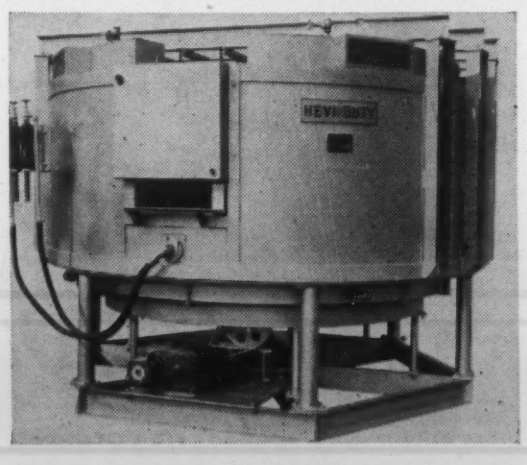
With a nominal magnesium content of 0.9%, K155 in the as-received condition does not have the dark coloraton characteristic of the high magnesium-containing alloys such as 52S. K155 is available in plate, flat sheet, coil and circle forms in all tempers in the H1 and H3 groups. The H1 temper series is used for applications requiring relatively simple forming; the stabilized H3 series is recommended where moderate or severe forming is involved.

Austenitic Alternate Steel Developed for 18:8 Stainless

An austenitic alternate steel for 18:8 stainless has been developed by *Allegheny Ludlum Steel Corp.*, Pittsburgh 22, which is said to offer good cold working properties, good weldability and ductility.

Produced with manganese, chromium, and less than 1% nickel as principal alloying elements, this steel offers promise of widespread usefulness. After being under development for many months chromium-manganese stainless strip is now being produced in substantial quantities, and is available in most other forms. It is expected to be the vanguard of a new family of steels that will be a permanent addition to the stainless market.

In applications where critical requirements include the mechanical properties of welds, ductility, non-magnetic qualities, and cold working to high strength, the chromium manganese steels should be considered. However, present types of manganese austenitic stainless steels are not cure-alls for every application, particularly where extreme corrosion resistance is required. It is expected that where straight chromium steels are serving satisfactorily as an alternate for the 18% chromium, 8% nickel steels, consumers will continue their use.



This unit has many uses such as scale-free hardening or as a high temperature forging furnace.

Electric Rotary Hearth Furnace Features Close Control

Exact temperature and atmosphere control are important features of a new furnace offered by *Hevi Duty Electric Co.*, Milwaukee 1, which is designed to operate continually at temperatures to 2500 F. The high temperature furnace has a rating of 260 kw with a capacity of 1500 lb per hr.

Silicon carbide rod type heating elements which are arranged vertically can easily be replaced even while the furnace is hot. A protective atmosphere is used to maintain a bright surface during hardening and to prevent the decarburization of these special high temperature alloys. Within easy reach of the operator is a variable speed drive mechanism which can be adjusted for the desired speed of the rotating hearth to match production needs.

A process of continuous operation can be obtained as the operator loads the furnace by placing the cold parts on the 7 ft dia hearth which is slowly rotating and removing the heated work as it passes the door opening. The door opening is 18 in. wide and adjustable between 6 and 10 in. in height. For the benefit of the furnace operator, a water cooled face over the chamber opening has been installed.

The versatile unit has many uses such as scale-free hardening or as a high temperature forging furnace.

New Blackening Process for Stainless Steels, Cast and Malleable Iron

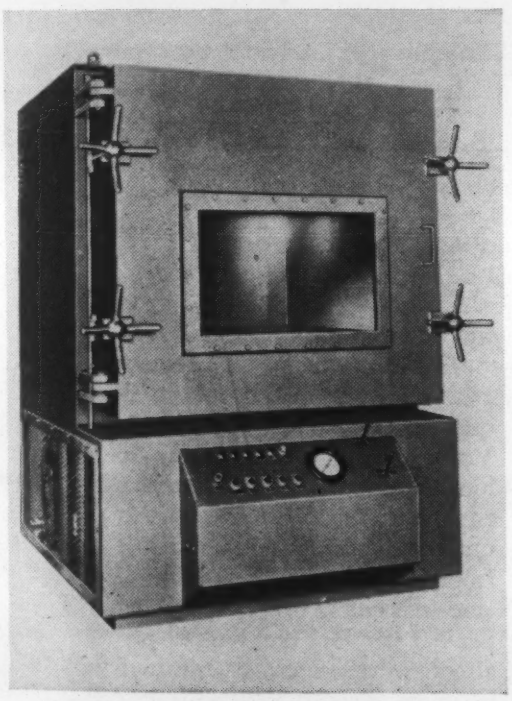
The Mitchell-Bradford Chemical Co., 2446 Main St., Stratford, Conn., has introduced a new process for blackening stainless steels, cast and malleable irons. Black Magic S.S. is a one salt mixture, one bath process operating at a temperature of 255 to 260 F. It is said to produce a lustrous, adherent black finish which will not chip, flake or peel. Immersion time in the blackening solution is from 5 to 15 min.

An economical and inexpensive finish to apply, cost of application for chemicals is less than ¼ cents per sq. ft. The parts to be finished can be processed in baskets and in a few cases should be racked. A large amount of work can be processed in a relatively small volume of solution.

The blackening solution is made up by using 5 to 5-½ lb of Black Magic S.S. blackening salts for each gallon of solution and in this proportion will give a boiling point of 255 to 260 F. It should be noted, however, that the salts are highly caustic and goggles should be worn by the operator. When handling the salts, rubber gloves should be worn.

Processing procedure is as follows:

1. Immerse in hot alkali cleaner until soils are removed from parts.
2. Rinse in cold water.
3. Pickle for 5 min. (50% muriatic acid at room temperature.)
4. Rinse in cold water.
5. Pickle for 30 sec (15 to 40% sulphuric acid—140 to 160 F.)
6. Rinse in cold water.
7. Immerse in Black Magic S.S. Solution (255 to 260 F.) until pieces take on black color.
8. Rinse in cold water.
9. Final oil or wax dip.



This unit makes fast tests.

Multi-Purpose Environmental Test Unit

A new multi-purpose environmental test unit which provides an extremely wide range of temperature, vacuum and humidity conditions, has recently been introduced by *Murphy & Miller, Inc.,* 1322 S. Michigan Ave., Chicago. Heavy duty electronic control circuits with automatic safety interlocks assure fast, foolproof operation under any laboratory or production testing programs.

Called an Altitude Simulation Chamber, the unit permits accurate testing of materials and equipment under all externally imposed conditions of heat, cold, moisture and vacuum.

Available with a wide variety of optional equipment such as program heating, cooling and humidity cycles, with automatic recorder for controlling and integrating temperature, humidity, altitude, the unit is designed to meet all government altitude simulation test standards.

According to the company the basic construction of the unit, which consists of a reinforced plate steel strength shell surrounding the test chamber, provides greatly increased insulating area and efficiency which permits important installation and operating economies through the use of less power and the advantage of lighter weight.

Two heavy duty hermetically sealed compressors assembled into a Cascade type refrigeration system, operate through all welded copper cooling coil circuits for maximum operating performance and long life. A high capacity, low velocity two speed fan system is used to maintain uniform temperatures and conditions of extreme altitude.

Heat Resistant Adhesive Has Exceptional Strength

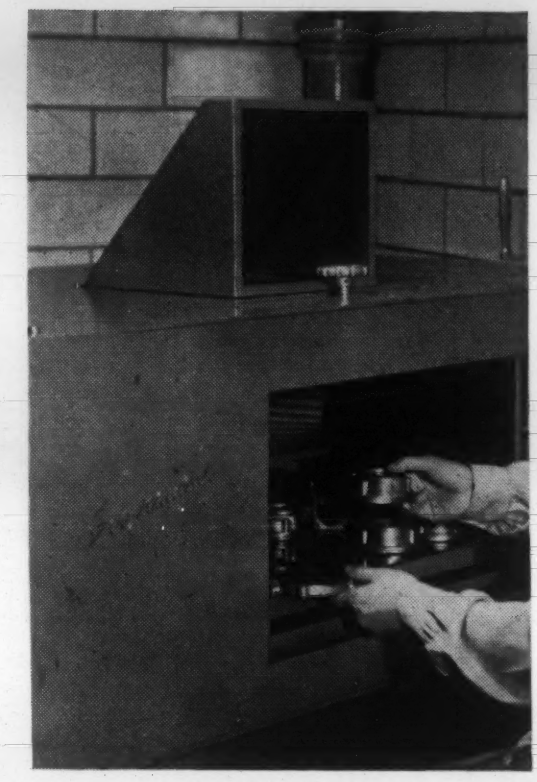
A new waterproof, high heat resistant adhesive with exceptional strength and durability has been announced by *Chemical Development Corp.,* Danvers, Mass. It is a thermosetting, self curing cement. Heat is not required. The final glue line is completely resistant to salt and fresh water, fungus, and many acids, solvents, and lubricating oils. It is neutral when cured and will not decay cellulose fibers as will adhesives which are acid upon final cure.

CD Cement 300 will have many uses in the shipbuilding, furniture, plastic, construction, aviation, and other industries which require a very high strength bond that will not dry out or lose its strength on aging. It is intended for conformance with Military Specifications MIL A5433, A5434, A397A, and AXS 1665.

One application for the new adhesive is for laminating oak and other woods for ship keels and timbers. It is also being used for bonding phenolic and urea plastic sheets (Formica, Micarta, etc.) to themselves and to wood and other surfaces for furniture and industrial products.

Nylon can be bonded to nylon without heat or pressure. Also, this product is of interest for cementing Lucite and Plexiglas to wood for outdoor signs because of its good weathering characteristics.

New Materials and Equipment continued



Industrial Fluoroscope for Mass Inspection of Light Alloy Castings

The X-Ray Dept., General Electric Co., 4855 Electric Ave., Milwaukee 14, has announced a new type of industrial fluoroscope designed for the mass inspection of light alloy castings made by sand, permanent mold, die or other techniques; and also for the inspection of plastics products. The Scopemaster is also useful for mass inpection of concealed assemblies, hydraulic, mechanical or electrical components; and for quick and efficient guidance of new product development.

Of particular interest is the mechanism provided for moving the product in the x-ray beam on a special turntable. A single external control handle permits moving of parts to be inspected in any lengthwise or crosswise direction while in the x-ray beam. In the case of castings, this facilitates inspection of fillets and corners. The distances between the receiving screen and the product part can also be adjusted by the operator.

Mass inspection of light alloy castings, plastics products, are uses for this industrial fluoroscope.

The new unit is said to provide economical 100% inspection of critical castings, and thus give a greater assurance that these will give good service in use and that rejects will be held to a minimum. Costly machining time can be conserved by fluoroscoping raw castings before they are machined to detect subsurface flaws.

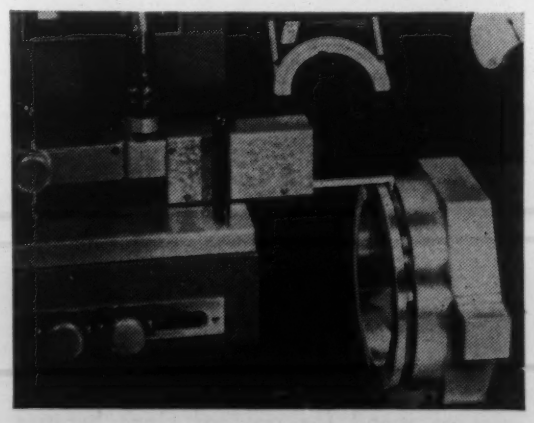
The unit operates from a 110-v 60 cycle source. It has a 9 by 19 in. front opening through which products are inserted for viewing. Internal cavities .040 in. in size, on approximately 6% of the metal thickness in an aluminum alloy casting, can be detected.

Two New Glass Fiber Reinforcing Mats

Two new mats for plastics manufacturers have been announced by *International Glass Corp.,* Los Angeles. They are Interglass Uni-directional Plastics Reinforcing Mat and Interglass Surfacing Mat with GS-1 treatment, both utilizing the exclusive company method of manufacture with long continuous glass fibers laid in a parallel pattern instead of short staple fibers laid at random.

The surfacing met with GS-1 finish (a vinyl silicone resin) produces amazing results in standard boil tests according to the company. It shows no flowering or fiber migration after eight hours in manufactured items such as cafeteria trays and other products where the attack of water on glass interfaces is a serious problem. Wet strength and resistance to weathering are increased many times in molded products surfaced with this mat; because it is held by a 5% polyester binder, it affords greater pliability in the molding of compound curves. The mat is available in 15-mil and 30-mil (40-120-mil on special order) and comes in standard rolls of 48 in. wide and 400 ft long.

The reinforcing mat is extremely tough and durable, made of the long fibers quilted on one-inch centers, treated with Volan sizing and held by a polyester binder. The company claims a weight-per-square-foot variation of less than 4% uniform thickness and negligible deviation from length dimension. The mat is available in weights of ¾, 1, 1¼, and 1½ oz. per sq ft for the single ply and can also be ordered cross-laminated with two or three plies.



This unit measures surface roughness.

Surface Roughness Tracer for Flat-Bottomed Grooves

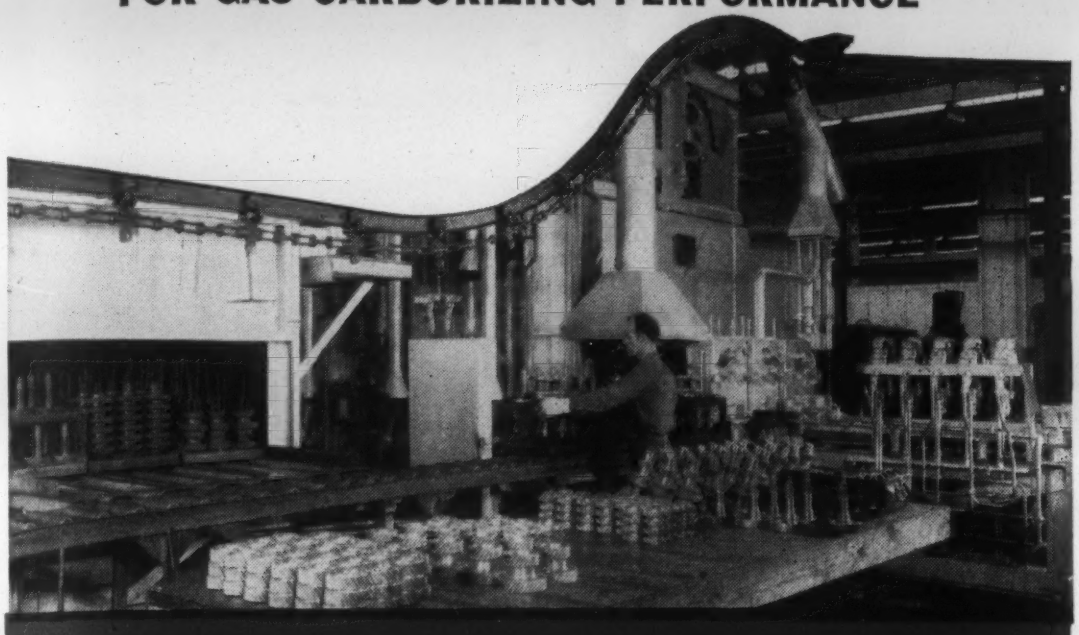
Micrometrical Manufacturing Co., 345 S. Main St., Ann Arbor, Mich., has announced the Profilometer Type KB Tracer for measuring surface roughness across the bottom of flat-bottomed grooves to ¼ in. depth and behind shoulders to ¼ in. height. When measuring crosswise, it permits 1/16 in. length of trace in grooves of 5/32 in. width, and greater length of trace in wider grooves. The Tracer can also be used in ID's from 25/64 in. to flat, and on all OD's and flats, where the part can be mounted on a Linear Pilotor with the work surface horizontal.

To permit reaching down into grooves and over shoulders, the unit has no skids, and the Tracer point is at the bottom of a vertical extension at the end of a long beam. This construction requires that the Tracer be supported and moved mechanically by a Linear Pilotor.

(Continued on page 116)

FORECASTS

FOR GAS CARBURIZING PERFORMANCE



You'd be amazed (as we are sometimes) at the long memories possessed by some of our furnace engineers. On short notice they'll give you the serial number, location and performance data on furnaces that we installed as long as 10 or 15 years ago — and they're generally right. The point is, the best way to forecast the performance of a furnace not yet built is to check thoroughly the records of similar installations.

BASED ON 22 YEARS OF "HINDSIGHT"

We have built hundreds of gas carburizers for all types of production requirements. If you are interested in continuous gas carburizing for instance, we can point to the first installation of its kind in 1931. It's still doing a job as reported in our sixteen-page bulletin, SC-134, an important and valuable review of gas carburizing techniques and possibilities. Write for it, on your letterhead please.

Current 'Surface' Literature

YOURS FOR THE ASKING

You may find quick answers to your immediate heat treat problems in these recent Surface Combustion Technical Library publications. Ask for the ones most pertinent to your requirements and we'll send them promptly.

bulletins

SC-134	Modern Gas Carburizing
SC-158	RX Prepared Atmosphere Generator
SC-155	Prepared Gas Atmospheres
SC-149	Pit Type Controlled Atmosphere Furnaces
SC-147	Rotary Retort Controlled Atmosphere Furnaces

reprints

53-A	Pit Type Carburizing Furnaces Provide Flexible Setup
52-C	Continuous Carbon Restoration Furnace Boosts Production
49-E	Furnaces for Gas Carburizing
49-B	Homogeneous Carburizing
47-E	Influence of Water Vapor on Gas Carburizing Atmospheres

SURFACE COMBUSTION CORPORATION, TOLEDO 1, OHIO

ALSO MAKERS OF

Kathabar HUMIDITY CONDITIONING

Janitrol AUTOMATIC SPACE HEATING

Surface
HEAT TREATING EQUIPMENT

SILICONE
RUBBER PARTS

Your Molded or Extruded Parts can now be made of wondrous new Silicone Rubber . . . by Republic.

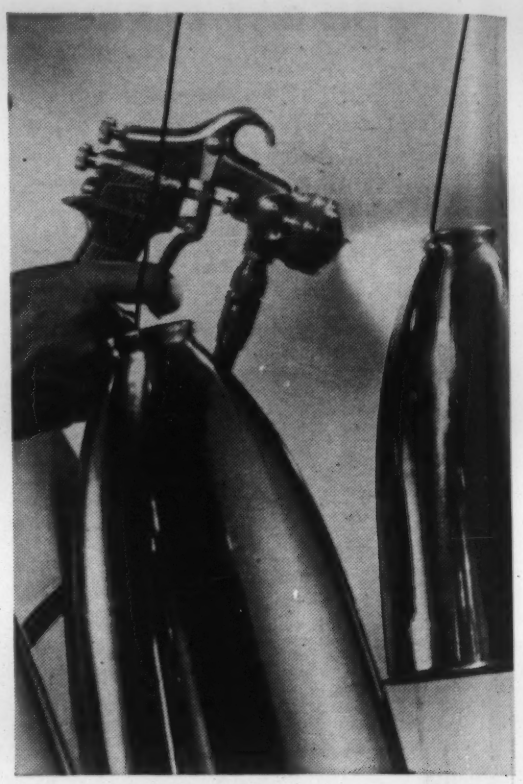
Send us your prints today. With more than 50 years' specialized experience in Industrial Rubber Products . . . with the most modern plant and production facilities . . . Republic Rubber is ready with the skill and personalized attention that assures you of high-quality Silicone Rubber Parts, formulated to a compound that exactly meets your requirements.

Let us show you how you benefit by using Silicone, the new, heat-resisting, non-sticking, inert rubber compound accurately fabricated to your specifications by Republic, the specialist in Industrial Rubber Products.

Your local Republic Distributor can help you plan, select, apply and maintain any Product of Industrial Rubber. If his name is not listed in the yellow section of your telephone directory, write us for his name and address.

REPUBLIC RUBBER DIVISION
LEE RUBBER & TIRE CORPORATION, YOUNGSTOWN 1, OHIO
INDUSTRIAL RUBBER PRODUCTS

New Materials and Equipment

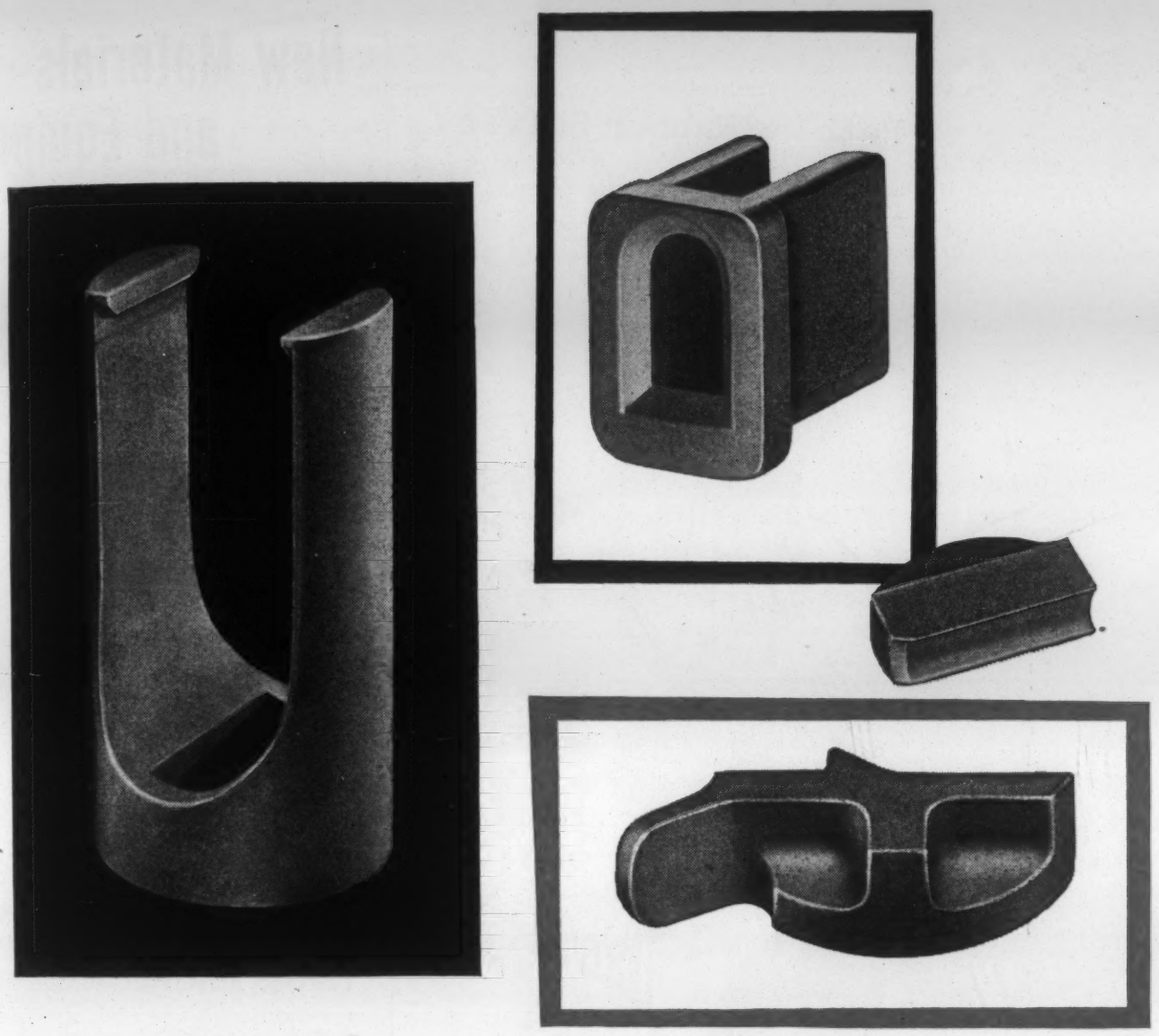


New Butyrate Resin for Finishes

A new cellulose polymer, half-second viscosity cellulose acetate butyrate, has been announced by *Tennessee Eastman Co.*, 260 Madison Ave., New York 16. While cellulose acetate butyrate is not new, having been used in plastic molding compositions, airplane dopes and other specialized coatings, its use in the finishing industry has been limited. After careful evaluation of the new butyrate in terms of wood lacquers, metal finishes, paper finishes, etc., company reports showed that half-second butyrate produces excellent wood lacquers. These lacquers, it is claimed, afford a higher degree of protection against ultraviolet light than nitrate lacquers—a particularly important factor in blond furniture finishes where direct sunlight causes nitrate finished surfaces to darken in exposed areas. It is also claimed that these butyrate lacquers withstand 10 "cold check" cycles —demonstrating at least a partial solution to furniture manufacturers' age-old problem of surface checking brought about by rapid temperature changes.

According to the company, the new butyrate also produces exceptional metal lacquers. Such lacquers exhibit considerably greater resistance to weathering than nitrate lacquers and retain their initially low color much longer. The company claims that metal finishes made from half-second butyrate neither whiten during underwater immersion tests, as do most varnishes, nor blister or peel as do nitrate finishes under the same conditions.

Butyrate finishes were also shown to be far less flammable than nitrate finishes. Unlike nitrate, which must be shipped wet with solvent, the raw half-second



improve product design . . .

cut manufacturing costs

with ACCUMET PRECISION INVESTMENT CASTINGS

In many cases design is restricted and function limited when alloy steel parts are made on conventional machinery from bar stock or forgings. Frequently such designs can be improved and production costs lowered by the use of precision investment castings. That's because this casting process permits the use of high alloy steels that are difficult to machine or forge.

Take these four component parts of a pneumatic tool for example. They are Accumet Investment Castings made by Crucible of 8620 steel. They have a smooth, satiny finish and are held to very close tolerances. If these parts were not made by this "lost wax" process, the pneumatic tool could not be produced at a practical cost in its present design.

Crucible engineers and metallurgists are available to help solve design and production problems through the use of Accumet Precision Investment Castings. Write now, and let them help you solve yours.

CRUCIBLE first name in special purpose steels

53 years of Fine steelmaking

ACCUMET PRECISION CASTINGS

CRUCIBLE STEEL COMPANY OF AMERICA, GENERAL SALES OFFICES, OLIVER BUILDING, PITTSBURGH, PA.

REX HIGH SPEED • TOOL • REZISTAL STAINLESS • ALLOY • MACHINERY • SPECIAL PURPOSE STEELS

Roth Rubber Solves
Rubber Problem
for West Coast
Manufacturer!

A simple problem for the rubber technologist, you may say. But it's significant that Tektronix, Inc.—of Portland—had Roth Rubber—in Chicago—provide the solution to this one:

Designed for television broadcasters and research laboratories, the Tektronix 524-D Oscilloscope provides the engineer with a close-up of any line or portion of the picture, enabling him to make a fine determination. This wonderful electronic instrument depends, for its viewing efficiency, on a simple, inexpensive viewing hood supplied by Roth.

The viewing hood must fit—has to adjust to any face—has to keep room light from penetrating the viewing area during observation. It must not crack or buckle.

What's YOUR rubber problem? Roth Rubber can help you, too!

• *Thirty Years in Business—Custom Manufacturers of Industrial Rubber Products since 1923*

Request Roth's Counsel—NOW!

Get Roth technical assistance without obligation. We'll be glad to help you solve your rubber problem. Write or mail coupon today.

ROTH RUBBER COMPANY

1856 S. 54th Avenue, Chicago 50

Send Roth Manual
Please comment on attached description of our rubber problem or production rubber requirements.

Name_____
Position_____
Company_____
Address_____
City_____ Zone___ State____

New Materials and Equipment

butyrate can be handled as a dry powder with complete safety.

Other fields of application for the new butyrate polymer include paper lacquers which provide tough, transparent coatings highly resistant to grease, water and lipstick; lacquers for various plastics, including acrylics, cellophane, phenolics and polystyrene; peelable plastic coatings for the packaging industry; heat sealing adhesive coatings and hot melt coating compositions.

Adhesive Bonds Polyethylene to Non-Porous Surfaces

American Resinous Chemicals Corp., Peabody, Mass., has announced a new emulsion adhesive for bonding polyethylene to paper, aluminum foil, and non-porous surfaces. Good adhesion has been obtained in the past by solution adhesives, but it has been difficult to obtain satisfactory bonds with ordinary emulsion adhesives.

Arcco 980-21D is being used for many difficult applications such as attaching labels to polyethylene bottles, in the manufacture of barrier wrap materials for the Armed Services, and for many other applications where non-porous materials are involved.

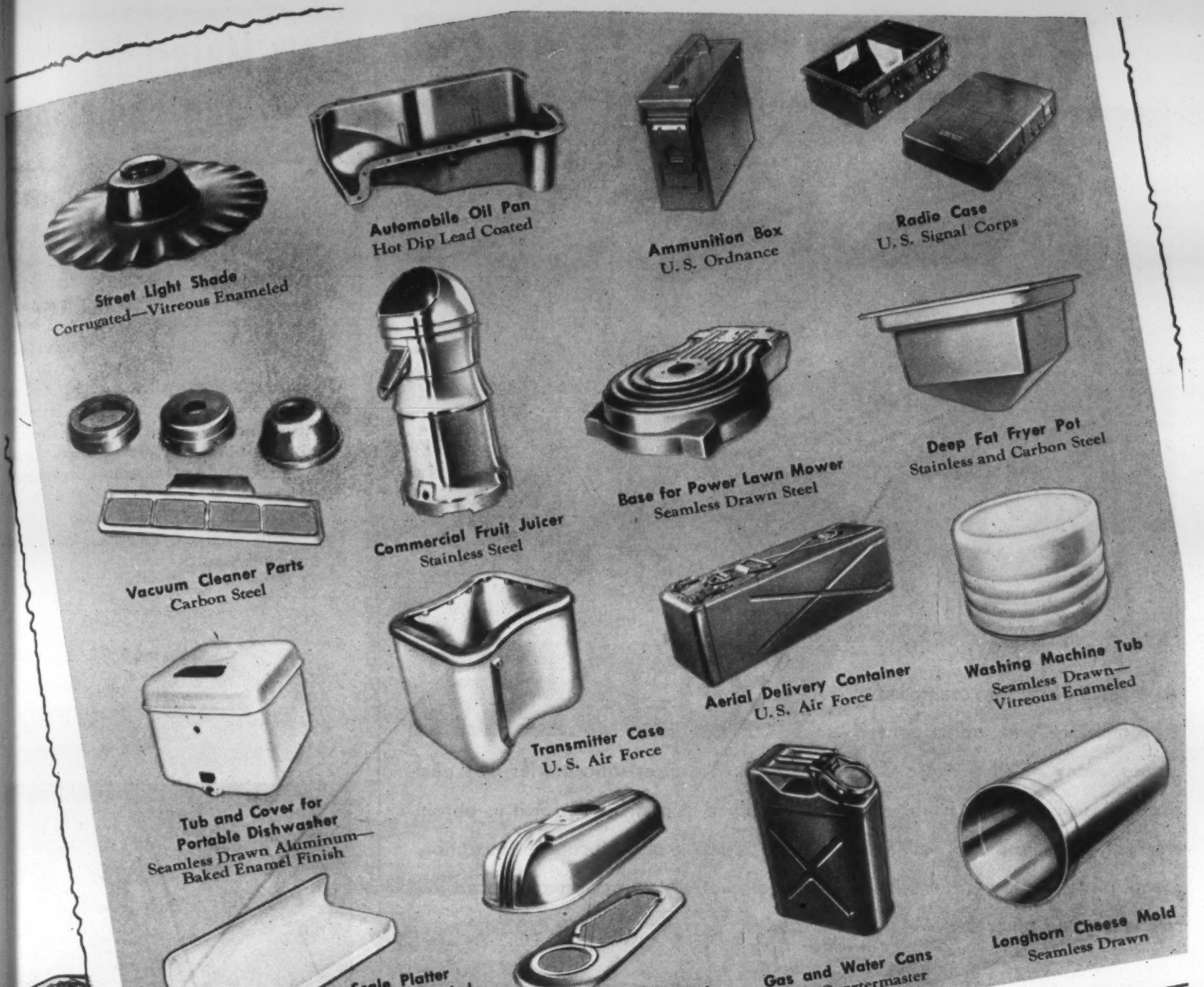
The adhesive can be applied by conventional spreader equipment, by roll coater or by brush.

New Process Makes High Performance Printed Circuit Units

Exceptional performance of printed circuit resistor and RC networks is said to result from a new insulating process developed by *Vacumet, Inc.*, 1267 N. Clybourn Ave., Chicago 10. The process seals these units in a series of humidity and atmosphere barrier layers which forms a tight, unitary insulating shell.

The unique feature of this process is that the insulation consists of four layers: two of these are filled organic resins and the other two are thin, impervious "skins" of hard, inert inorganic matter.

The printed circuit units which embody



DO *Your Products* FIT INTO THIS PICTURE?

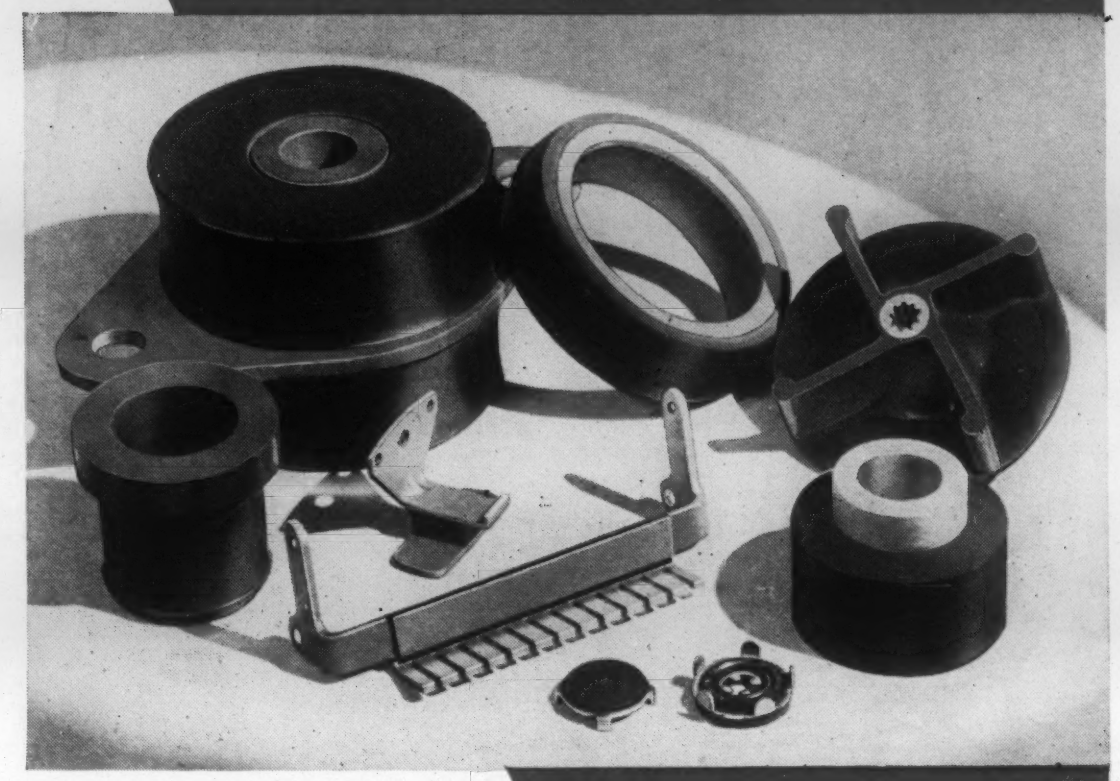
Metal stampings have been the specialty of G. P. & F. for over 73 years. The illustrations above show just a few typical examples of contract parts we make for hundreds of customers. If you use deep drawn or stamped metal parts in your products, the chances are good that we have the facilities to meet your requirements. When you think of G. P. & F., think of over 1000 skilled people . . . 15 acres of production facilities . . . 293 deep draw and stamping presses . . . 97 welding machines . . . and a complete tool and die department.

G.P.&F.

Stamping • Drawing • Forming
Galvanizing • Welding
Lead Coating • Spray Finishing
Vitreous Enameling • Fiberglas

GEUDER, PAESCHKE & FREY CO., 1538 W. St. Paul Ave., Milwaukee 1, Wis.

RUBBER-TO-METAL BONDING



As a result of modern compounding, molding and adhesion techniques, many of which were developed in the Acushnet laboratories, the best properties of metal and rubber can be combined in one bonded unit to obtain strength, toughness and resiliency, as well as shock and vibration absorption, sound abatement, electrical insulation or conductivity, corrosion and abrasion resistance, and other desirable advantages.

Acushnet's specialization in this relatively new field involves the adhesion of rubber or synthetic rubber to metal in molds designed to accommodate the metal parts and which, in addition to bonding the rubber material to the metal, form and vulcanize the rubber in the same operation.

With extensive equipment and facilities for solvent degreasing, sandblasting, cementing and brass plating, Acushnet bonds rubber to metal by several processes, each suited to a particular application for the most efficient adhesion. Our engineers will gladly study your prints and make prompt recommendations.

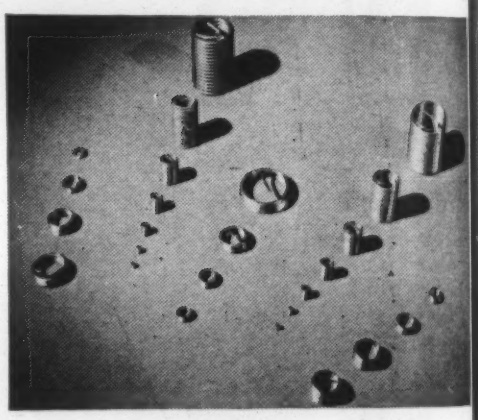
Acushnet
PROCESS COMPANY

Send for brochure "Rubber-to-Metal Bonding." Detailed information concerning applications, design, procedures, compounding, processes, bond strength ratings, etc. Illustrated.

Address all communications to 750 Belleville Ave., New Bedford, Mass.

this new insulation process are made on a customer specification basis by the company and are trade named Mummies because of their method of encasement. Steatite, high K dielectrics, glass and other materials are employed as base materials for the printed circuit units.

Printed resistors, when incorporated in the Mummies, indicate shelf life stability of better than 1%. Negligible changes in value due to humidity are reported. Load life, noise and resistance-temperature characteristics are improved by a factor of from 15 to 25% over those of conventionally insulated elements, according to company reports.

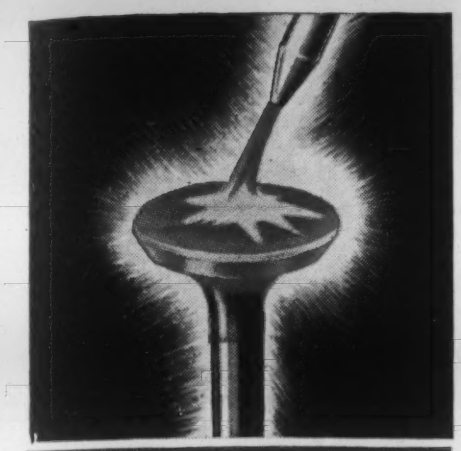


Availability of 47 Standard Wire Thread Insert Sizes Announced

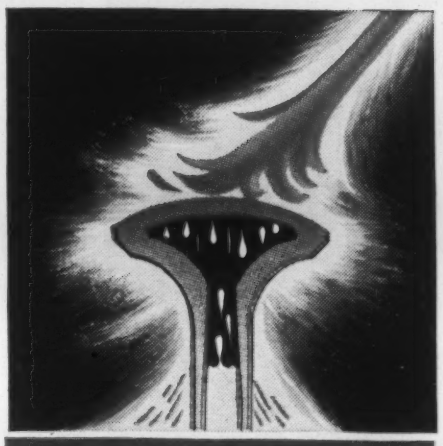
Heli-Coil Corp., 1330 Shelter Rock Lane, Danbury, Conn., has announced the availability of 47 standard sizes of wire thread inserts—5 in the Automotive Spark Plug Series, 17 in the National and Unified Coarse Thread Series, 6 in the National Pipe Thread Series, 15 in the National and Unified Fine Thread Series and 4 in the Aviation Spark Plug Series.

A breakdown of these size ranges is as follows: 10-1.0 mm to 7/8-18 in the Automotive Spark Plug Series; 4-40 to 1½-6 in the National and Unified Coarse Thread Series; 1/8-27 to 1-11½ in the National Pipe Thread Series; 6-40 to 1½-12 in the National and Unified Fine Thread Series; and 14-1.25 mm to 18-1.5 mm in the Aviation Spark Plug Series. Inserts for the National and Unified Thread Series are supplied in 1, 1-½, 2, 2-½, and 3 dia. lengths. For special applications, non-standard thread sizes and lengths can also be supplied.

Heli-Coil wire thread inserts are finding use in the following industries: automotive, aviation, home appliance, shoe machinery, construction equipment, air



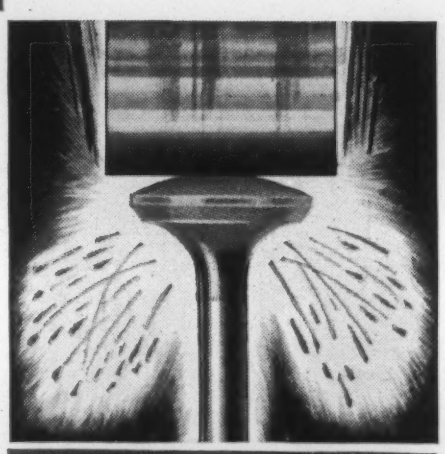
HARD-FACE WELDING



SODIUM HEAT TRANSFER

These facilities ...this special know-how

...may hold ideas you can use NOW



FORGING TOUGH ALLOYS

Every day the Valve Division is welding thousands of pounds of high-alloy coatings to unusual Thompson-developed alloys to give internal-combustion engine valves added life under super-severe service.

We also insert highly-combustible metallic sodium into hollow valve stems to make engine valves run cooler and last longer.

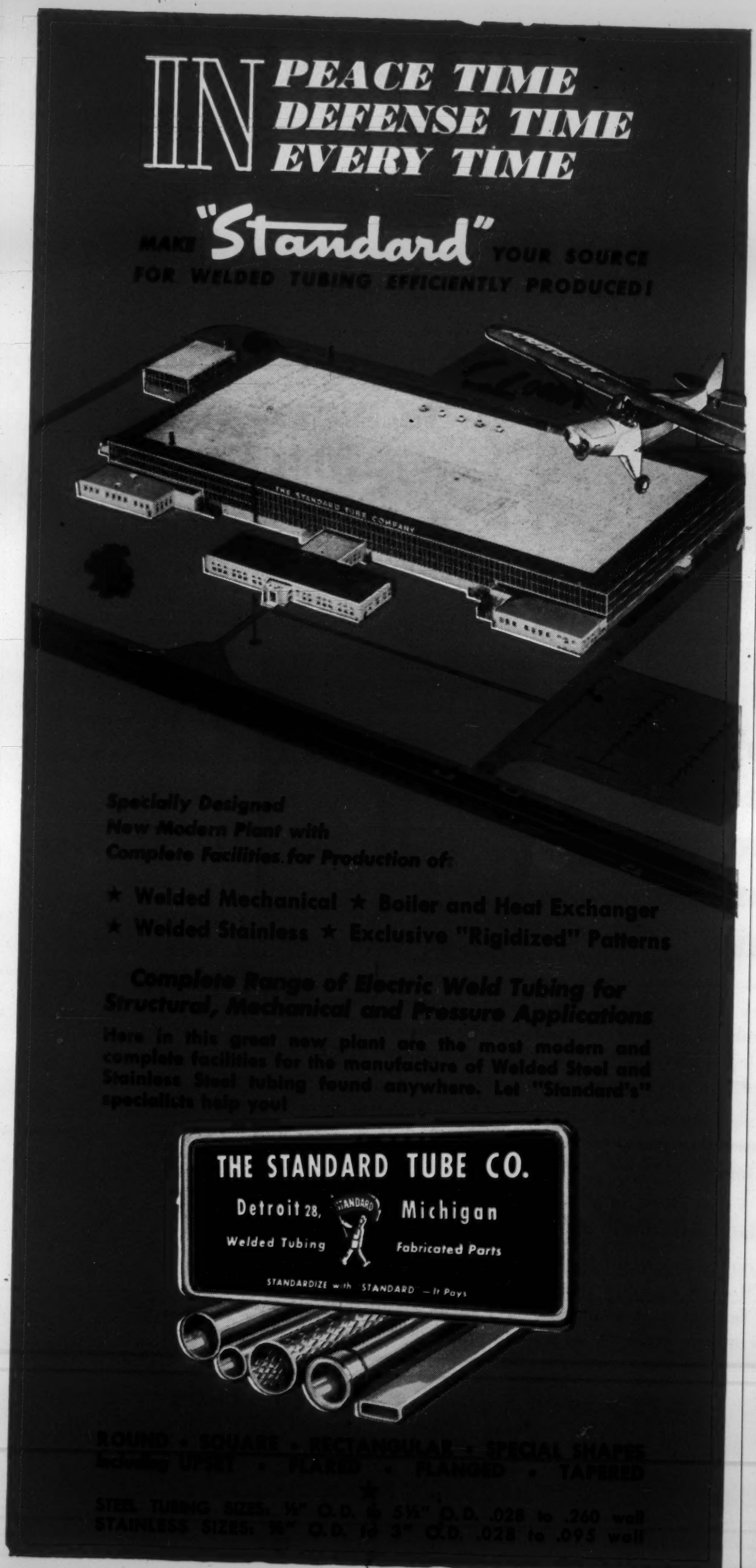
The Valve Division also knows plenty about forging and finishing extra-tough alloys to precision limits.

If you have out-of-the-ordinary production problems, you'll want to know more about Thompson know-how and facilities. And, if you have ideas about how we can help on new projects, we'd like to talk them over with you.

VALVE DIVISION

Thompson Products, Inc.

DEPARTMENT VR-7 • CLEVELAND 17, OHIO



New Materials and Equipment

conditioning, business machine, motorcycle and sports car, marine engine, textile equipment, coin machine, furniture, materials handling, electronic equipment, railroad and heavy industrial machinery.

Although intended primarily for use in original equipment manufacture, these inserts are also used in production salvage operations (to repair threads damaged during manufacture) and in maintenance operations (to repair threads damaged during use).

In aluminum, magnesium, iron, steel, brass, bronze, fiber, wood and plastics, these stainless steel inserts provide higher loading strengths and greater resistance to wear, vibration, seizing, galling and corrosion than unprotected tapped threads.

Two New Paint Strippers Offered

Oakite Products, Inc., 132H Rector St., New York 6, has announced the development of two new paint strippers, Oakite Composition No. 56 and No. 57, designed respectively for tank immersion stripping and brush-on stripping of a wide variety of alkaline-resistant paints and lacquers.

Oakite No. 56 is a thin-bodied solvent, neutral in character, having a pH of 7. It is nonflammable and contains no phenols, cresols, acids or alkalies. Designed for immersion stripping of ureaformaldehyde, alkyd, phenolic and urea-melamine finishes, lacquers, varnishes, wrinkle finishes and vinylite resins, the material is used at full strength and unheated. Parts to be stripped are immersed for periods of time which will vary, depending on the type of paint, number of coats, age, etc. Some finishes will wrinkle and rinse off in sheets with a pressure rinse after application of the stripper; others will soften to the point where they can be scraped or brushed off. Used as recommended, No. 56 is said to be safe on steel, brass, copper, zinc, magnesium and aluminum, and can also be used on wood since it des not tend to raise the grain appreciably.

The second of these materials, Oakite Composition No. 57, is a viscous solvent intended to replace combinations of nonviscous solvent detergents and thickeners when stripping finishes from vertical and inverted surfaces of equipment. It is noninflammable and, like No. 56, contains no phenols, cresols, acids or alkalies. It can be applied safely on all metals at full strength by brush-on methods, and is allowed to soak on surfaces until paint wrinkles or softens. Paint is then hosed or scraped off. Many phenolics, alkyds, ureas, vinyls, varnishes, and lacquers are readily removed by this material, while

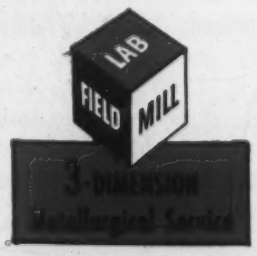
Business "HEADACHES" relieved with Republic 3-DIMENSION METALLURGICAL SERVICE

First comes the examination of your steel "headache". . . machinability, or tool life, or heat treatment, or surface finish, or excessive rejects, or any of the problems that you face in production. Here's where you meet the Republic Field Metallurgist.

He discusses the symptoms with the other two members of Republic 3-Dimension Metallurgical Service . . . the Republic Mill Metallurgist and the Republic Laboratory Metallurgist. They look at your symptoms from all three angles . . . the best Republic Alloy Steel to do the job properly, to work efficiently in your plant to keep your costs down.

Then . . . back comes the Republic Field Metallurgist with recommendations that will give you the quality your product requires at the speed you need to show a profit.

Got a steel headache? Tell your Republic Sales Office representative about it . . . he'll have a Republic Field Metallurgist in your plant promptly.



. . . combines the extensive experience and coordinated abilities of Republic's *Field*, *Mill* and *Laboratory* Metallurgists with the knowledge and skills of your own engineers. It has helped guide users of Alloy Steels in countless industries to the correct steel and its most efficient usage. IT CAN DO THE SAME FOR YOU.

REPUBLIC STEEL CORPORATION
Alloy Steel Division • Massillon, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N. Y.

Republic
REPUBLIC STEEL
ALLOY STEELS

How Armour ammonia and service helped International Harvester CUT COSTS!

Carbonitriding reduces hand work, provides greater safety than liquid cyaniding

Because liquid cyaniding of small parts for their famous heavy duty trucks meant high labor costs, International Harvester was looking for a more efficient method of case hardening. Their metallurgists decided that carbonitriding would provide the answer, and with the help and advice of the Armour Ammonia Technical Service Department they had the necessary equipment installed.

The change was even more successful than they had hoped. International's Fort Wayne plant reported lower labor costs, as expected, in carbonitriding thrust washers, shifting forks, brackets, miscellaneous pins, and similar small parts. They also found that carbonitriding's circulating gases assure a more uniform case on intricate parts. And carbon and nitrogen concentrations are more accurately controlled, resulting in fewer rejects. Finally, working conditions were much improved.

Carbonitriding has been proved in plants of many other companies. It has reduced costs and increased safety. In many cases Armour men have given advice and help on installations. This help and advice is just part of Armour's service to our ammonia customers. Since 1947 Armour has sponsored a fellowship at Massachusetts Institute of Technology for the study of carbonitriding and other similar metal treating processes. This knowledge is from basic research, and available to everyone. Perhaps even more important, the men of Armour's Technical Service Department are equipped to handle and answer any problem arising with ammonia installations for metal treating. The booklets offered below will show you how to put this knowledge to work for you. Write today for your free copies. And, if your problems are unusual or pressing, write giving full details of your requirements.

You can depend on Armour's ammonia and service

ARMOUR *Ammonia Division*

Armour and Company • 1355 West 31st Street • Chicago 9, Ill.

CLIP AND MAIL THIS TODAY!

Please send me copies of the following booklets:

☐ "Applications of Dissociated Ammonia" ☐ "The Nitriding Process"
☐ "Ammonia Installations for Metal Treating" ☐ "Carbonitriding"

Name..... *Title*.....

Firm.....

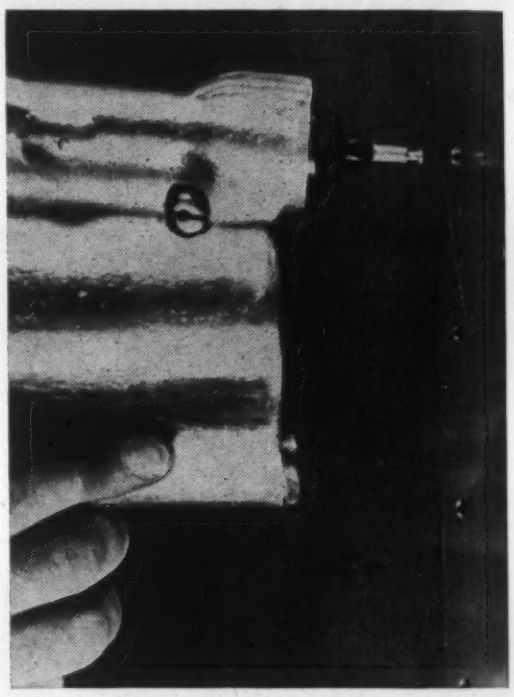
Address.....

City..... *Zone*..... *State*.....

New Materials and Equipment

some finishes may require more than one application.

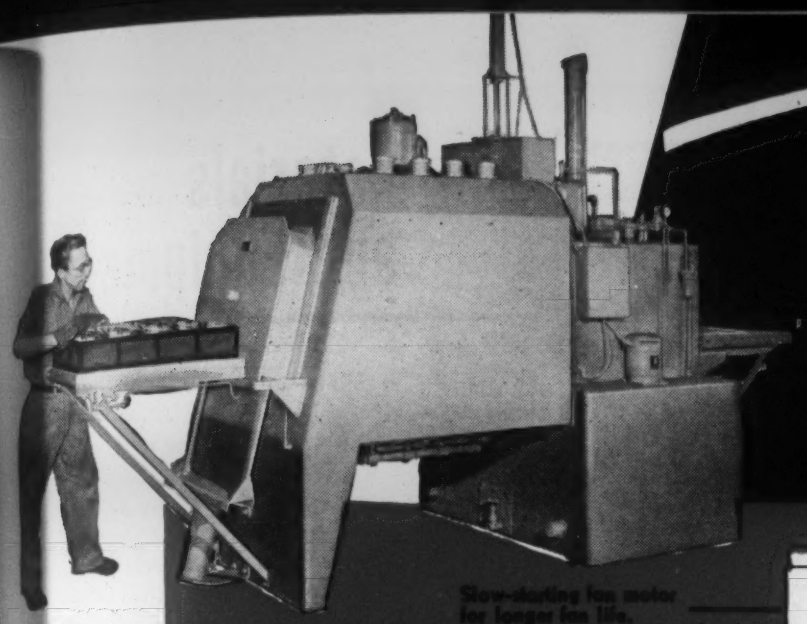
When work stripped with either No. 56 or 57 is to be repainted, the manufacturer recommends thorough rinsing to remove all stripping material, since any solvent stripper film remaining on surfaces will prevent proper adherence of new paint coat applications.



New Rivet Speeds Fastenings at Low Cost

A rivet that is said to cut costs, make blind spots as easy to handle as open sections, and that can be driven without a dolly, has been introduced on the American market by J. C. Rhodes and Co., branch of United Shoe Machinery Corp., New Bedford, Mass. The rivet can be driven by inexperienced operators at a rate up to 1200 an hr. Known as the Pop rivet, it is available only in Monel and aluminum. Much of the production to date has been in Monel, because of its high strength and adaptability to upsetting and other forming.

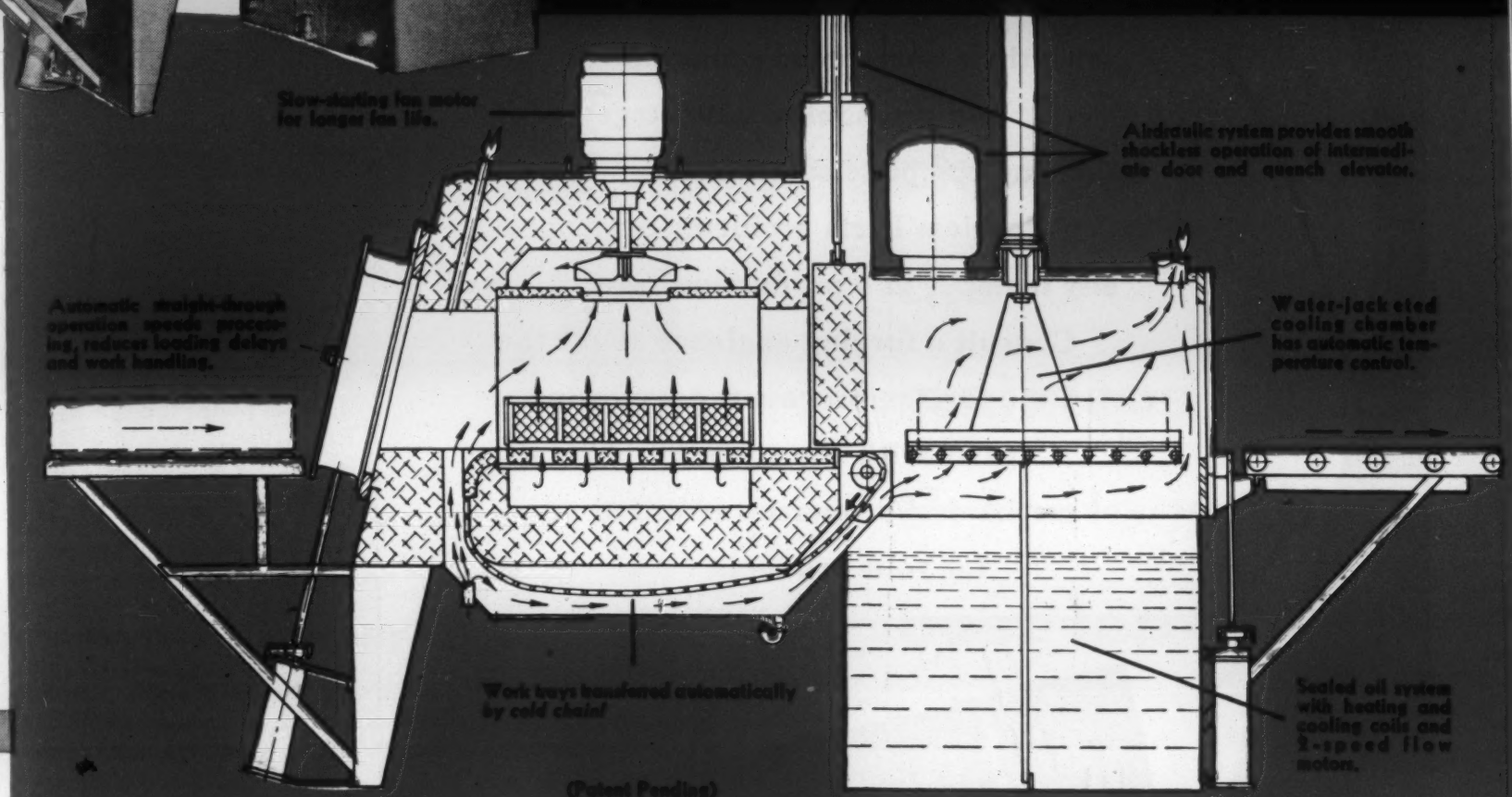
Deep drawn from strip stock, the rivet can be used to fasten most commercially available metals and alloys. The fastener consists of the rivet itself, and an inserted mandrel of high strength steel. The mandrel looks much like a finishing nail. The mandrel, with its attached rivet, is slipped either into pre-drilled holes in the work to be fastened, or into the fastening tool and then into the hole. The fastening tools can be operated manually and pneumatically. They can be fitted with interchangeable heads and extensions

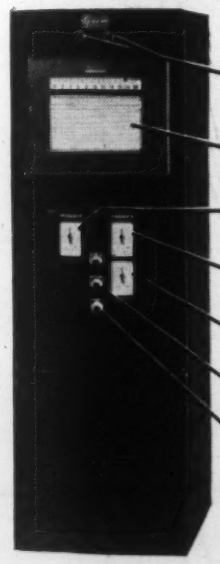


Now Ipsen

100% FORCED CONVECTION CONTROLLED ATMOSPHERE UNITS

For Temperatures Up to 1850° F.





SIMPLE CHANGE-OVERS

Change-over from one process to another is simple, quick, and easy. Settings for heat, atmospheres, quench, and oil flow is all that is required. Cycle is then controlled automatically.

★Above is a cross-section view of the Ipsen 400 Lb./Hr. Furnace showing the advanced design features which have made Ipsen the largest manufacturer of carbonitriding and batch-type heat treating units. With these new units, you get the advantages of 100% forced convection heating and controlled atmosphere processing, *plus* the full benefits of automatic straight-through operation. Thus, you eliminate loading delays and guess-work. You control distortion and get uniform results from batch to batch . . . today, tomorrow, or next year. You eliminate blasting and pickling operations and you can often use lower grade, less costly steels.

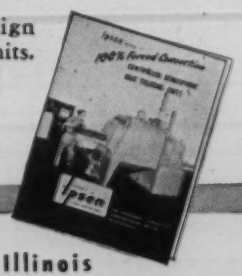
A SINGLE UNIT HANDLES ALL OF THESE OPERATIONS

Unusually versatile, the Ipsen is built for temperatures up to 1850° F., and a single unit is equipped to handle all of the following processes:

ATMOSPHERE COOLING	OIL QUENCHING
Normalizing	General Hardening
Stress Relieving	Carburizing and Hardening
Carburizing	Carbonitriding
Carbonitriding	Martempering

Send **Samples for Free Estimate** — find out how the new Ipsen Units can be applied to your job. Samples of your work will be run, procedures established in our new, modern lab, and cost estimates given without obligation.

Write **for New Literature** — illustrates new design features, gives complete specifications of various units.



MORE THAN 375 IPSEN HEAT TREATING UNITS ARE NOW SERVING INDUSTRY

AUTOMATIC Ipsen HEAT TREATING UNITS

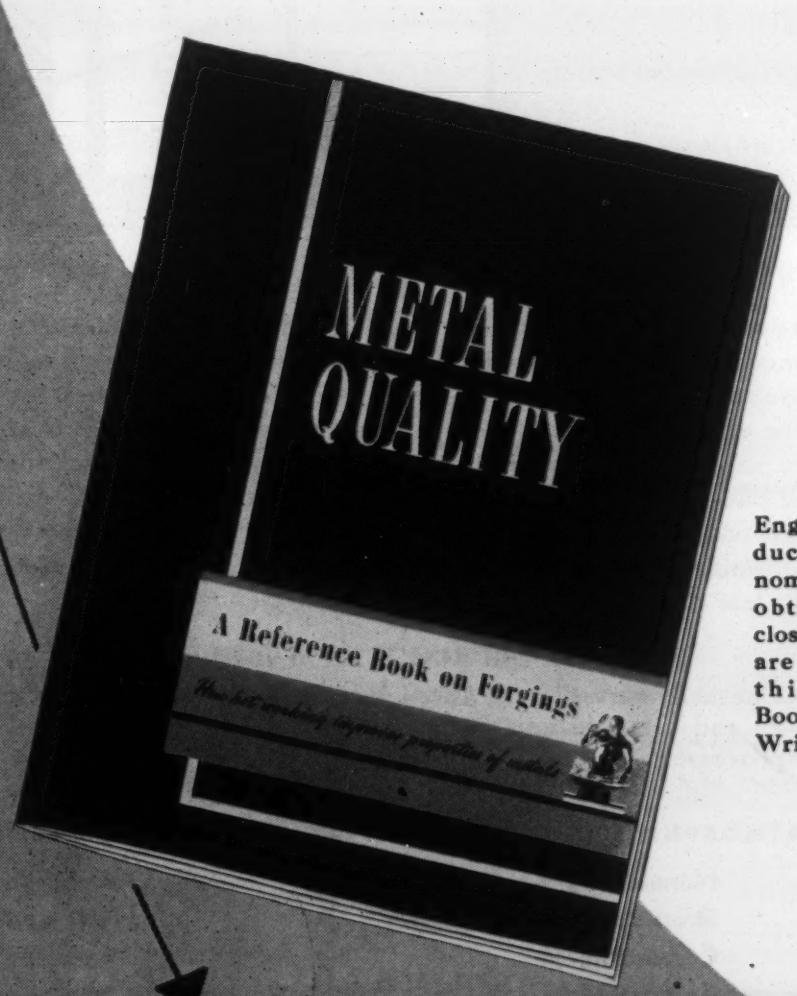
IPSEN INDUSTRIES, INC. 720 South Main Street; Rockford, Illinois

Universal Units to CARBONITRIDE • CARBURIZE • HARDEN • BRAZE • MARTEMPER • WASH • TEMPER

Forgings—closed die forgings—

with their unmatched economic and mechanical advantages offer quick and complete solutions for Problem Parts problems confronting any member of a production team.

Consult a forging engineer about the closed die forging process for producing parts with the correct combination of mechanical properties required for your product.



Engineering, production and economic advantages obtainable with closed die forgings are presented in this Reference Book on Forgings. Write for a copy.

DROP FORGING ASSOCIATION
605 HANNA BLDG • CLEVELAND 15, OHIO

Please send 60-page booklet entitled "Metal Quality — How Hot Working Improves Properties of Metal," 1949 Edition.

Name _____

Position _____

Company _____

Address _____

New Materials and Equipment

to operate at any desired angle or position.

In operation, the collet of the tool grips the shank of the mandrel and pulls while the nose of the tool presses firmly against the head of the rivet and holds it clamped tightly against the face of the section to be fastened. Simultaneously, the collet pulls the shank of the mandrel, thus expanding the inside end of the rivet to fasten it tightly against the inside surface of the work. This action serves to draw the sections of the work firmly together and clinch them in position. The mandrel is so designed that the head will break when the expansion has reached a point sufficient to provide maximum holding powers. The head then falls off and the shank is pulled through the rivet. If preferred, the mandrel head can be retained in the end of the rivet, through the use of the break stem type of mandrel.

In Great Britain, many uses already have been developed for the rivets. These include rivet-fastened sections of airplanes, truck bodies, cooking ranges, passenger automobiles, refrigerators, railroad coaches, roofing, and the like. They do not loosen through vibration and are cheaper under some conditions than other fasteners. Pop fasteners offer the additional advantages over solid rivets in that they do not require skilled operators, eliminate the denting of sheets by hammers, and permit, in many cases, the use of thinner sheets. In Monel, the rivets are actually stronger, under some conditions, than solid aluminum rivets.

Monel rivets are produced in sizes from 7/64 in. up to 3/16 in. dia. and in lengths from 0.190 in. to 0.750 in.

Embedded Conductors for Miniaturized Circuits

In-bedded circuits, developed by *Vacumet Inc.*, 1267 N. Clybourn Ave., Chicago 10, are said to provide the designer of electrical and electronic equipment new opportunities for miniaturization of circuits and components.

The in-bedded process consists of embedding solid metal conductors which are formed into any desired circuit pattern, into the face of a suitable insulating base.

The base material can be plastic, glass or ceramic and a special molding process makes the metal conductors and the base an integral unit. The exposed faces of the conductors can be molded to lie in precisely the same geometric plane as the face of the insulating base, thereby permitting smooth-riding, low-friction contacting in miniaturized commutator appli-

choose the stainless that does the best job

No one stainless steel meets every set of service conditions. And you should not pay extra for special properties you don't need. You can economize too, by selecting alloys especially designed for your fabricating processes.

Crucible produces around thirty standard alloys and many other special types of REZISTAL stainless steel. To help you choose the proper grade, our field representatives are prepared to bring you the latest and most complete metallurgical and fabrication data available on the application of stainless steel. And our plate, sheet, strip, bar, wire and tube mills are equipped with the most completely automatic controls for rolling, annealing, heat treating, finishing and polishing to assure you of unvarying quality in every piece of Crucible REZISTAL.

For assistance in solving application problems and the finest quality in stainless steels, call Crucible.

CRUCIBLE first name in special purpose steels

53 years of Fine steelmaking

STAINLESS STEEL

CRUCIBLE STEEL COMPANY OF AMERICA, GENERAL SALES OFFICES, OLIVER BUILDING, PITTSBURGH, PA.

STAINLESS • REX HIGH SPEED • TOOL • ALLOY • MACHINERY • SPECIAL PURPOSE STEELS

AMERICAN CHEMICAL PAINT COMPANY

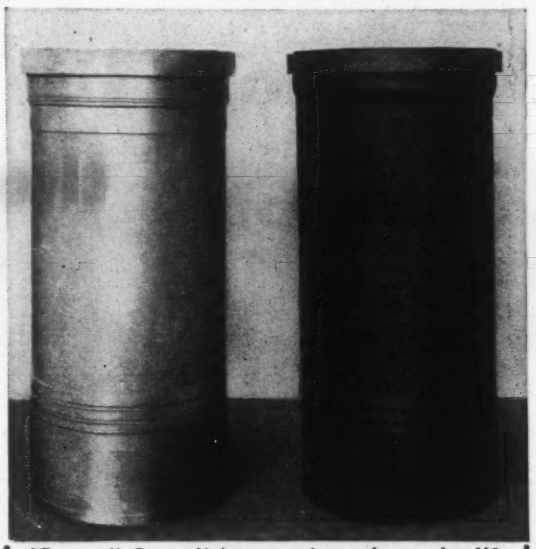
AMBLER CHEMICALS ACP PROCESSES PENNA.

Technical Service Data Sheet

Subject: PROTECTING FRICTION SURFACES WITH THERMOIL GRANODINE®

INTRODUCTION

Fabricators and product designers, particularly in the automotive field, are aware that even highly polished surfaces under friction weld, gall and score. One of the most inexpensive and practical methods of preventing this is to coat the metal to prevent metal-to-metal contact. With cast iron or steel, the "Thermoil-Granodine" manganese-iron phosphate coating provides a wear-resistant layer of unusual effectiveness.



Thermoil-Granodizing greatly prolongs the life of parts subject to friction. It protects the surface of products like the diesel engine liners shown above and the many moving parts of automobiles and other machines. "Thermoil-Granodine" with its remarkable lubricating properties is particularly valuable in these and similar applications because of its ability to retain oil and maintain lubrication under high pressures and high velocities. This ACP wear-proofing chemical not only permits rapid break-in without scoring, scuffing and welding but also reduces subsequent wear on friction parts.

"THERMOIL-GRANODINE" PROTECTS RUBBING PARTS

Thermoil-Granodizing removes "fuzz" from ferrous metal friction surfaces and produces a coating of non-metallic, water-insoluble manganese-iron phosphate crystals which soak up and hold oil as bare untreated metal cannot do. The oiled crystalline "Thermoil-Granodine" coating on piston rings, pistons, cylinders, cylinder liners, cranks, cam-shafts, gears, tappets, valves, spiders and other rubbing parts, allows safe break-in operation, eliminates metal-to-metal contact, maintains lubrication and reduces the danger of scuffing, scoring, welding, galling and tearing of the metal. The work to be protectively treated is merely Thermoil-Granodized and oiled, usually with a soluble oil.

"THERMOIL-GRANODINE" MEETS THESE SPECIFICATIONS

SPECIFICATION NUMBER	SPECIFICATION TITLE
MIL-C-16232 Type I	Coatings — phosphate; oiled, slushed, or waxed (for ferrous metal surfaces) and phosphate treating compounds.
AN-F-20 (See also U.S.A. 3-213)	Finishes, for electronic equipment.
U.S.A. 57-0-2C Type II, Class A	Finishes, protective, for iron and steel parts.
U.S.A. 51-70-1 Finish 22.02, Class A	Painting and finishing of fire control instruments; general specification for
M-364	Navy aeronautical process specification for compound phosphate rust-proofing process.

CHEMICALS ACP PROCESSES

WRITE FOR FURTHER INFORMATION ON "THERMOIL-GRANODINE" AND ON YOUR OWN METAL PROTECTION PROBLEMS.

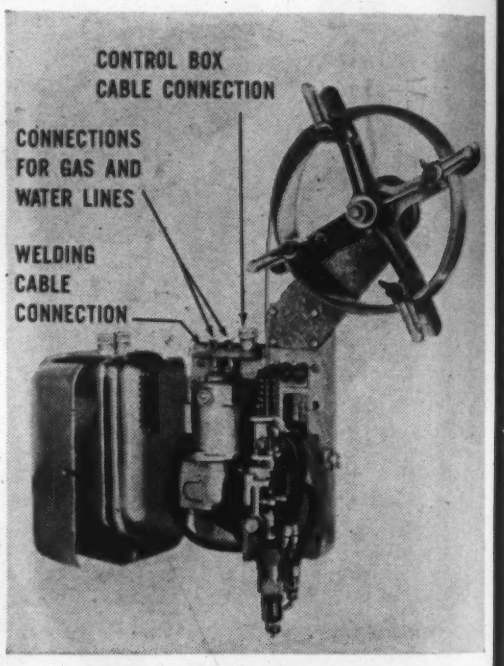
CHEMICALS ACP PROCESSES

New Materials and Equipment

cations. Contact bridging of closely spaced commutator segments can be completely eliminated with this method by use of rounded contacts.

Conductor line widths as narrow as .001 in. can be produced and intricate designs are readily reproduced. In-bedding wiring .005 in. wide can handle a continuous current load of 250 milliamps and the line width can be held to within ± 0.0002 in.

Circuit wiring, commutators, switches, inductors and other components can be made by the new process.



Lightweight Welder Features Arc Voltage Control

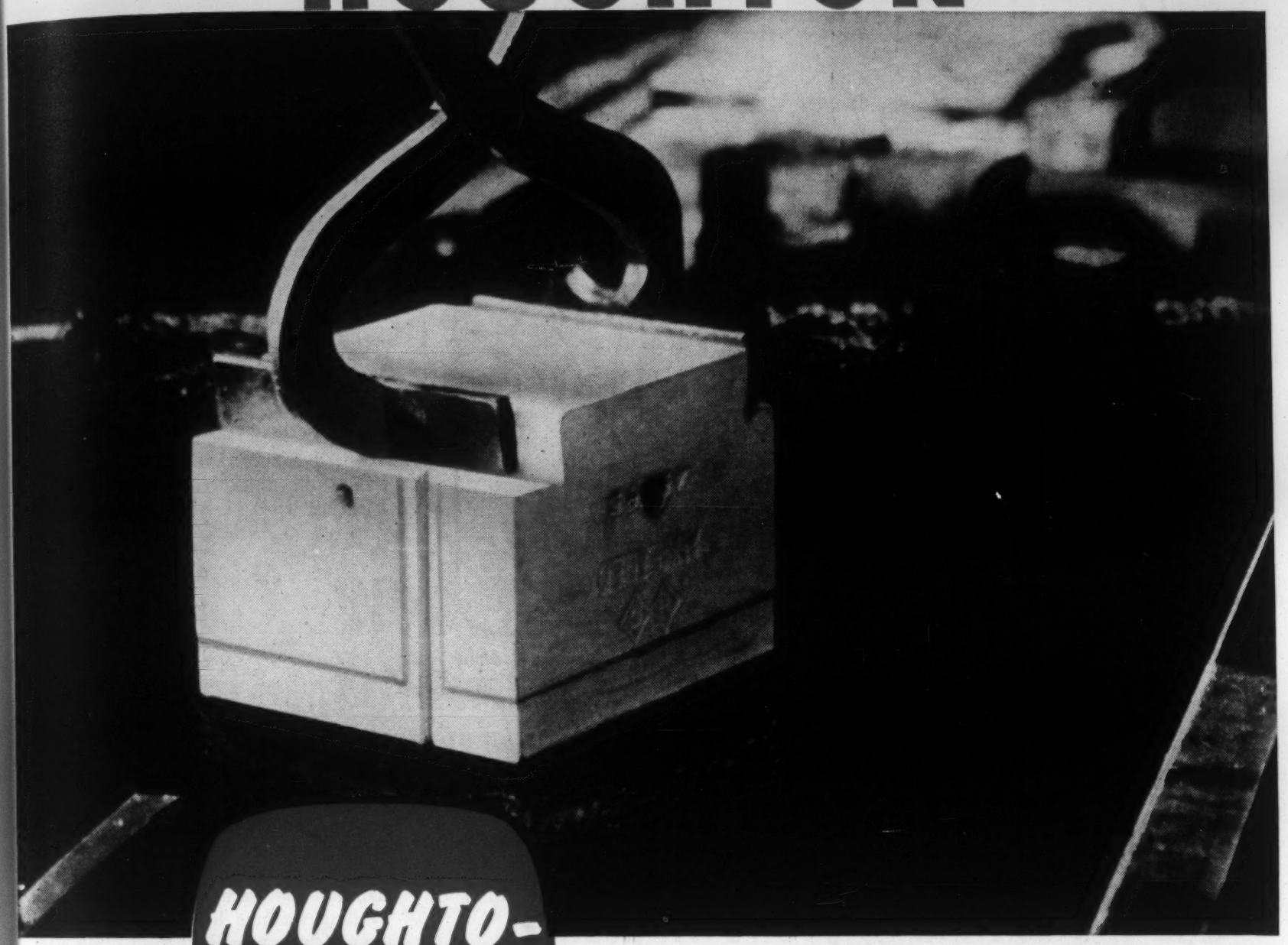
A new, lightweight shielded inert gas metal arc-welding machine, the SWM-3, announced by *Linde Air Products Co.*, 30 E. 42nd St., New York 17, features arc welding control. This feature is said to eliminate all welding problems that are due to a fluctuating arc voltage. Electronic controls maintain the proper balance of welding conditions by instantaneously speeding up or slowing down welding wire feed rate as required by changing arc conditions. Smooth, uniform welds are made as a result of this precise control over welding variables.

The electronic control unit does not get in the way of the welding operator or other work going on in the shop. And it does not have to be moved with the welding machine from one job to another. It can be permanently mounted anywhere, as long as it is properly connected to the welding unit.

The SWM-3 is easy to operate. All that the welding operator needs to do is preset the required voltage, and throw

1001 PRODUCTS . . . . . FOR BETTER PROCESSING

HOUGHTON



HOUGHTO-QUENCH... fastest oil quench for ANY steel!

We developed Houghto-Quench solely to meet today's requirements for speedier, surer quenching.

We gave it special properties to provide rapid wetting out qualities, maintain proper viscosity and give rapid rate of heat dissipation so you get faster quenching through the critical zone.

Our formula also includes an inhibitor which acts as a stabilizer and reduces oxidation. Houghto-Quench guarantees uniform quenching of any steel—even today's low alloy steels—and maximum hardness.

NEUTRAL PROOF

A user recently made his own comparative test of quenching speed and depth of hardness. Using a cone test and quenching from 1550°, he discovered that Houghto-Quench was 270% faster than the lowest priced oil offered him for quenching and 15% faster than the best competitive oil he could obtain. He's sold on Houghto-Quench!

Ask the Houghton Man for further information—or write to E. F. Houghton & Co., Philadelphia 33, Pa., for latest bulletin.

HOUGHTO-QUENCH

. . . a product of

E. F. HOUGHTON & CO.

PHILADELPHIA · CHICAGO · DETROIT · SAN FRANCISCO

Ready to give you on-the-job service . . .

"WHO CUT THIS 0.0006" UNDERSIZE?"

Reprinted with permission of the *American Machinist*

DO YOU NEED A

"PUTTIN'-ON-TOOL"

for salvaging undersize parts, worn tools and gages right in your own plant?

Now, with the Chromaster industrial chrome plating unit, you can restore undersize components or worn tools to exact dimensions, easily and simply, in a matter of minutes. With Chromaster, you will be able to salvage thousands of dollars worth of material you're now throwing into the scrap bin.

Here are the facts about Chromaster:

- **SIMPLE TO OPERATE**
- **NO PREVIOUS PLATING EXPERIENCE NEEDED**
- **FAST DEPOSIT RATE. .002" per hour**
- **CHEMICALLY STABLE PLATING SOLUTION**
- **LOW PLATING COST . . . only 7 mils per sq. in. .002" thick**

Now take a look at a few of the actual savings the Chromaster has made in other plants.

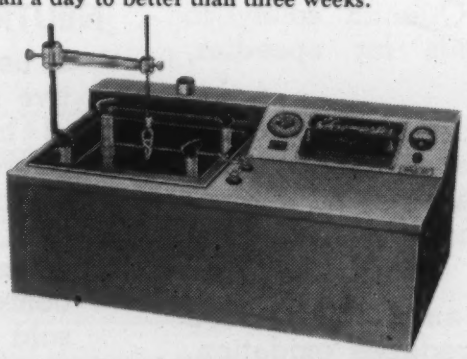
ACTUAL CHROMASTER SAVINGS

A CHICAGO TOOL COMPANY with 1500 shafts ground undersize used a Chromaster to return them to their original size with a surface finish of greater wear resistance.

A PHILADELPHIA MANUFACTURER used Chromaster to correct an oversized cylinder bore by plating to size.

A BROOKLYN FOUNDRY saved two grinding operations and almost five hours in plating time on every component with Chromaster.

A CALIFORNIA AIRCRAFT FACTORY salvaged expensive worn-down reamers with Chromaster. The new plating increased their useful life from less than a day to better than three weeks.



A CHROMASTER FOR EVERY SHOP

Model A-20 is a 20-amp, bench-mounted unit for the gage room or tool crib; plates up to 10 sq. in.

Model A-50, 50-amp, bench-mounted unit for larger shops in plating of cutting tools. Plates up to 25 sq. in.

Model A-250, 250-amp, floor-mounted unit for production plating of small parts in greater quantities or larger parts with areas up to 125 sq. in.

Chromaster

Write for money-saving free information today A•3•3

Industrial Chrome Division
Ward Leonard Electric Co.
16 South Street,
Mount Vernon, N. Y.

Please send me information on industrial chrome plating with CHROMASTER.

COMPANY.....

NAME..... TITLE.....

ADDRESS.....

CITY..... ZONE..... STATE.....

New Materials and Equipment

the starting switch. A retract starter built into the electronic control unit does the rest. It causes welding wire to feed down until contact is made with the work; then the wire retracts, drawing an arc. The wire then reverses direction a second time, and feeds down, maintaining the preset arc voltage.

Flexibility is another feature of the welder. The machine can be used to fabricate most commercial metals in almost any joint design. Butt, lap, fillet, and corner welds are made in aluminum alloys, stainless steels, carbon steels, deoxidized copper, Everdur, and aluminum bronze in thicknesses from 16 gage. Welding wires of 1/32, 3/64, 1/16 and 3/32 in. in diameters are used.

Multi-Purpose Tumbling Barrel

A new, improved barrel finishing unit designed to efficiently handle burnishing, de-burring and cutting-down operations has been announced by *The Abbott Ball Co.*, Railroad Place, Hartford, Conn. Outstanding features listed by the manufacturer include precision speed controls, interchangeable parts, and low operating costs.

Built around the high, vertical barrel which was first developed and marketed by the company, the new unit is compact and efficiently designed. Power is supplied by an electric motor mounted on the barrel pedestal. A standard motor base is provided to accommodate several sizes and makes of motor. Precision speed control is maintained by American reduction drive attached directly to the barrel shaft. Linkage between the motor and the reduction unit is provided by "V" belts and sheaves. Speed of the barrel is tailored to fit the user's requirements through a combination of sheaves. The unit is controlled with a conveniently located push-button safety switch which can also be used to jog the barrel to any desired position.

According to the company, the unit's improved design and the use of a highly efficient drive mechanism makes it possible to operate the barrel with a comparatively small motor. The reduction drive unit and "V" belts provide a low torque drive which produces a minimum shock and starting load on the motor. Normal operating speeds are reached almost instantly.

Interchangeability of parts is said to add versatility and economy to the new unit. Since end plates and side walls of all tumbling barrel bodies tend to wear out more rapidly than other parts, replacements are an important consideration. By providing interchangeable parts

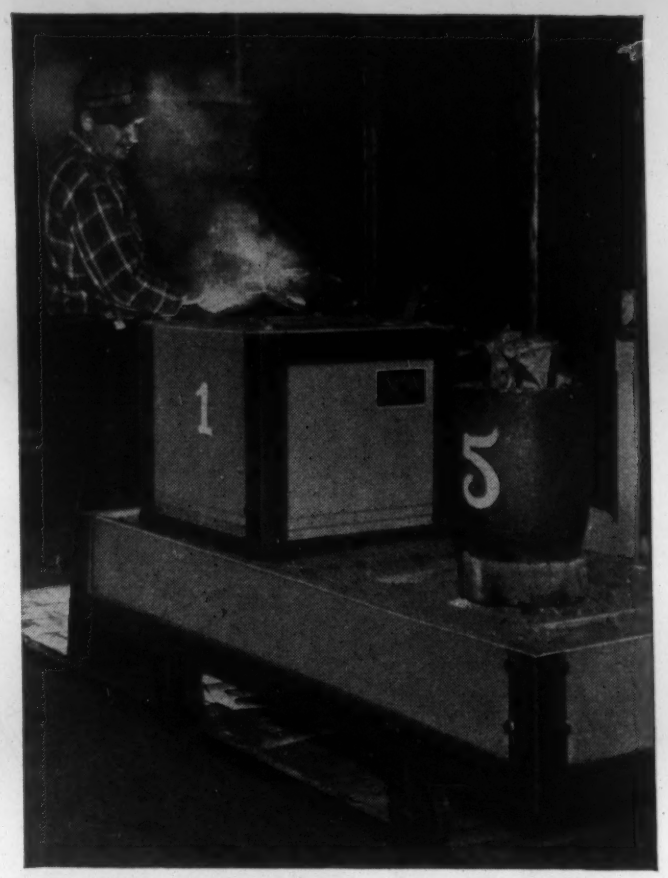
THE MOST *Economical* WAY TO MELT *Quality Bronze*

AJAX-NORTHRUP INDUCTION FURNACES

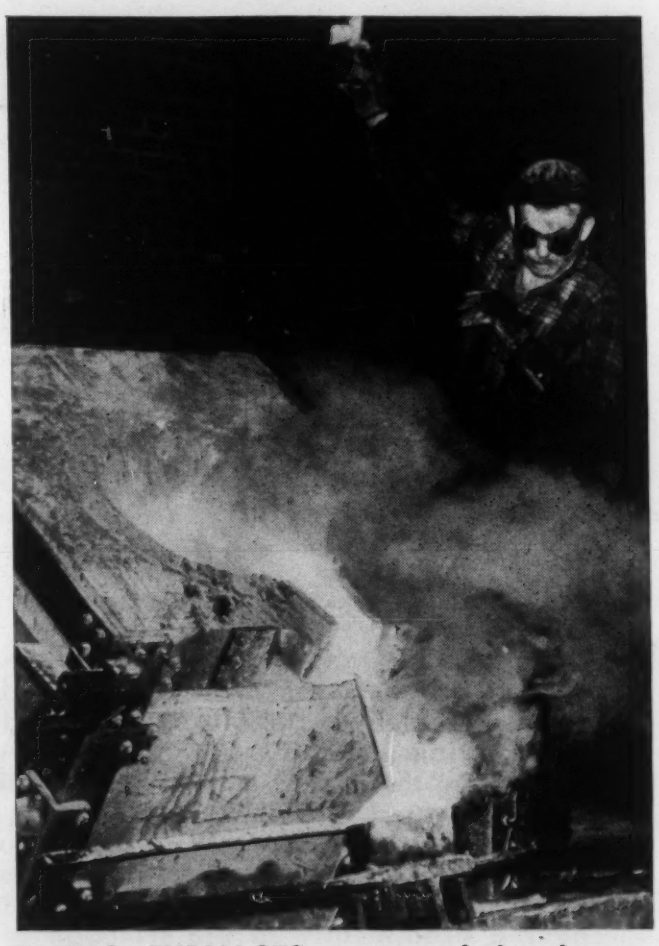
An Ajax-Northrup equipped bronze foundry, melting a wide variety of alloys in lift-coil furnaces, reports 10% higher tensile strength for certain of its induction-melted alloys... and has reduced melting costs by over $33.00 a ton at the same time!

Similar performance is reported by users of the larger tilting furnaces. The tilting units are slightly more efficient than the lift-coil equipment, and are used where ability to switch alloys frequently is less important.

If you haven't looked into the possibilities of induction melting for your non-ferrous foundry lately, we'd like to show you some of the data we've gathered from recent installations. Just write or phone us.



LIFT-COIL FURNACES *can melt different alloys simply by switching crucibles.*



TILTING FURNACES *are used for larger quantities, or special production runs.*

149

AJAX NORTHRUP

INDUCTION HEATING AND MELTING

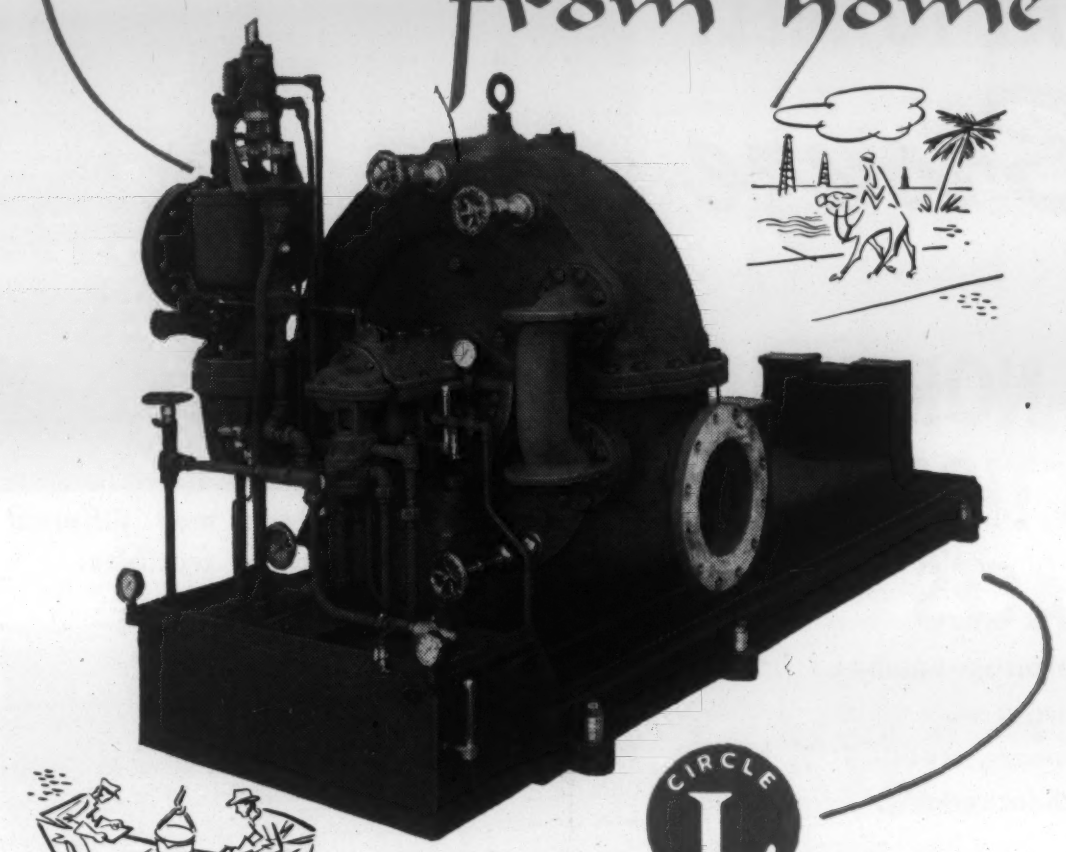
AJAX ELECTROTHERMIC CORPORATION
Ajax Park, Trenton 5, New Jersey

Associated Companies

AJAX ELECTROMETALLURGICAL CORP.
AJAX ELECTRIC FURNACE CORPORATION
AJAX ELECTRIC COMPANY, INC.
AJAX ENGINEERING CORPORATION

Since 1916

In turbines 7148 miles from home



LEBANON Castings are at work

ON the lonely oil fields of the Saudi Arabian desert nine turbines break the stillness with their steady whine of work. These are Terry Steam Turbine Company's Type C.S. Turbines, and all the castings in these turbines are made by Lebanon Steel Foundry. Driven by waste gas from the oil fields, they power heavy-duty pumps that deliver 100,000 barrels of oil a day.

Operating at 280°F., 450 pounds pressure, the turbines, which are among the largest natural gas turbines in the world, develop a mighty 1940 H.P. at 4400 R.P.M. Terry Steam and their customer, the Arabian-American Oil Company, know that satisfactory service is doubly important when replacement parts are thousands of miles away and repairs are costly. You can be sure that these factors figured prominently in the selection of Circle Ⓛ Steel Castings, products of true craftsmanship.

You should see — STEEL WITH A THOUSAND QUALITIES — A 37-minute 16 mm full color sound film on the making of steel castings. For information write: Dept. D, Lebanon Steel Foundry.

LEBANON Castings

CARBON, SPECIAL ALLOY AND STAINLESS STEEL

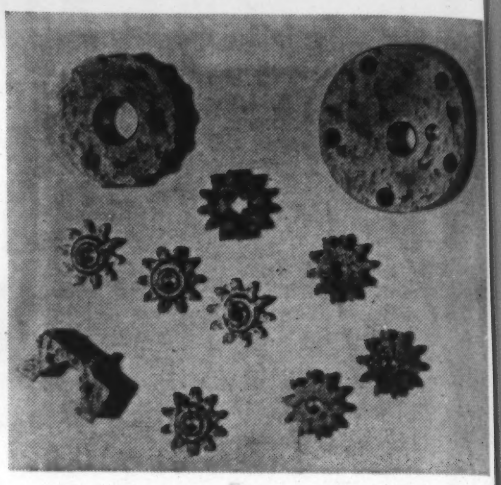
CIRCLE L

LEBANON STEEL FOUNDRY LEBANON, PA.

New Materials and Equipmen

for the barrel, a substantial savings i operating costs can be realized.

The new units are made in 4 standa sizes and are available in 10 basic co binations with single, double and trip compartments to fit the user's requir ments. Standard barrel I. D. sizes f single barrels equipped with maple li ings are 24 by 8, 24 by 16, 30 by 8, a 30 by 16 in.



Non-Porous Metal Powder Parts Possible by New Impregnating Process

All the advantages of powder metal parts—controlled composition, precision, intricate shapes, high production rates—plus the new advantage of non-porosity are now available to industry by a new impregnating process developed by *American Metaseal Manufacturing Corp.*, New York, N. Y.

In many places, such as in office machine parts, fuse parts, gears and cams, where the production advantages of sintered metals are desirable, yet where the natural porosity is undesirable, some method of filling the porosity is necessary. Hot coining and infiltration are too expensive. Yet without some form of impregnation, plating is almost impossible.

Plastic impregnants were tried, but the early types required refrigeration and other necessary storing and treating procedures that made them both ineffective and prohibitively expensive. Also, the solvents used to remove excess plastic from the surface of the part after impregnation attacked the material in the pores, nullifying the effect of the process. The significance of the Metaseal development is that a solid copolymer completely and permanently fills all porosity; and the excess resin is removed from the outside of the part with an emulsion type cleaner that does not attack the impregnant.

The final results of this economical

ROLOCK

FABRICATED HEAT AND CORROSION RESISTANT ALLOYS

LEFT: Parts entering roller hearth furnace on "Serpentine" trays.

BELOW: "Serpentine" trays on loading table.

"SERPENTINE" DESIGN *minimizes* WARPAGE... LOWERS HOUR-COSTS for FURNACE TRAYS

...at PRATT & WHITNEY AIRCRAFT

Rolock "Serpentine" furnace trays are carrying jet engine parts through a Westinghouse roller hearth furnace with an Exothermic atmosphere at maximum temperature of 2050°F.

Rolock quoted on another type of tray as well as the "Serpentine," but 100 "Serpentine" trays were purchased for original equipment and have so far had many months of continuous use... with additional orders placed during that time.

The exclusive Rolock Serpentine construction gives freedom to expansion and contraction in both directions, minimizing warping to a greater degree than any other furnace tray Rolock has seen. It is available to order in any practical length, width and depth... as a tray or as the base of a basket or crate.

Rolock engineers invite your requests for solution of specific metal treating problems. Our experience covers hundreds of nationally known industrial plants.

HEAT TREATING... OR CORROSION RESISTANT CATALOGS ON REQUEST.

Offices in: PHILADELPHIA, CLEVELAND, DETROIT, HOUSTON, CHICAGO, ST. LOUIS, LOS ANGELES, MINNEAPOLIS, PITTSBURGH

ROLOCK INC. · 1282 KINGS HIGHWAY, FAIRFIELD, CONN.

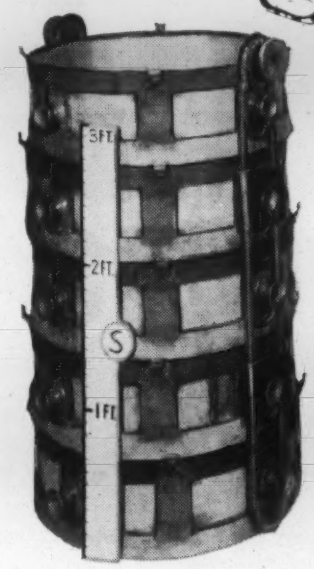
JOB-ENGINEERED for better work
Easier Operation, Lower Cost

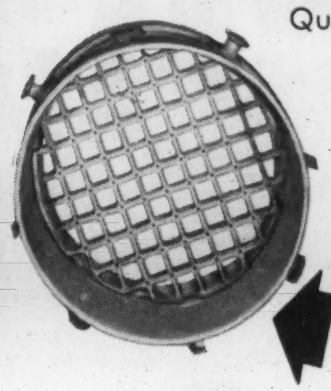
4RL53A

WELL STACKED!

FOR THE TRIP THROUGH YOUR HEAT TREATING FURNACE IF PARTS ARE LOADED IN

STANWOOD STACKING BASKETS





Each basket retains the one above it. Two or four trunions are optional. Quick-on lift bars. Baskets are durable, lightweight — heat resistant alloys. Bottom grid is reversible. Send for literature.

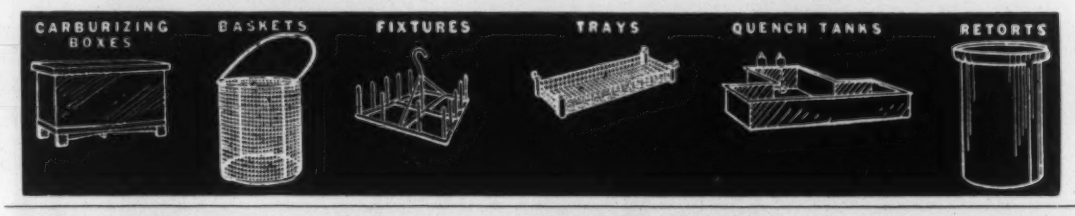
•

Reversible Bottom Grid. Wire Screen Bottom Liner available.

Stanwood Corporation

FABRICATED METAL PRODUCTS

4813 W. Cortland St. Chicago 39, Ill.



Porcelain Laboratory Mill Jars

These McDanel Metal Covered Jars are unbreakable in normal routine use.

That means longer life. While the price is competitive with the all porcelain jars the longer service spells out a distinct saving.

Porcelain Linings have straight sides and may be easily and thoroughly cleaned.

Made for both Roller and Cradle type mills. The Roller type jars have non-slip live rubber tires, which are so constructed to stay in place at all times.

Other features include live soft rubber gasket with close fitting cover that may be tightened by hand—no danger of cracking cover

Write today for "McDanel Industrial Porcelain" catalog

McDANEL REFRACTORY PORCELAIN CO.

BEAVER FALLS, PENNA.

GRINDING BALLS . . . MILL LINING BRICK . . .
MILL HEAD ASSEMBLIES . . . TANK & DRYER LININGS

New Materials and Equipment

process, according to company reports, are that all pores are invisibly filled, preventing corrosive action and permitting plating without subsequent spotting out, freckling, or blistering. The parts so treated become pressure tight, and withstand pressures of over 5000 psi.

New Soldering Flux for Ferrous and Nonferrous Metals

A new, extremely concentrated soldering flux for use on iron, steel, copper, bronze, brass, zinc, terne plate and many alloys is now offered by *Remont Manufacturing Co.*, 1310 Meyers Rd., Lombard, Ill. Designated Tins-tyter, the flux is said to assure tinning, instant positive bonding and thorough penetration into joints and seams of heavily oxidized metals or alloys difficult to solder.

Diluted with up to 4 parts water, it provides an equally effective and very economical flux for metals easy to solder. It is also suitable for solder-iron, flame or dip soldering, requires only the minimum heat necessary to melt the solder, and leaves clean lines and smooth surfaces. Flux residue can easily be removed with water. Tests indicate that soldered joints will usually resist stresses just as well as the metals themselves.

Stainless Steel Coating Available in Ten Colors

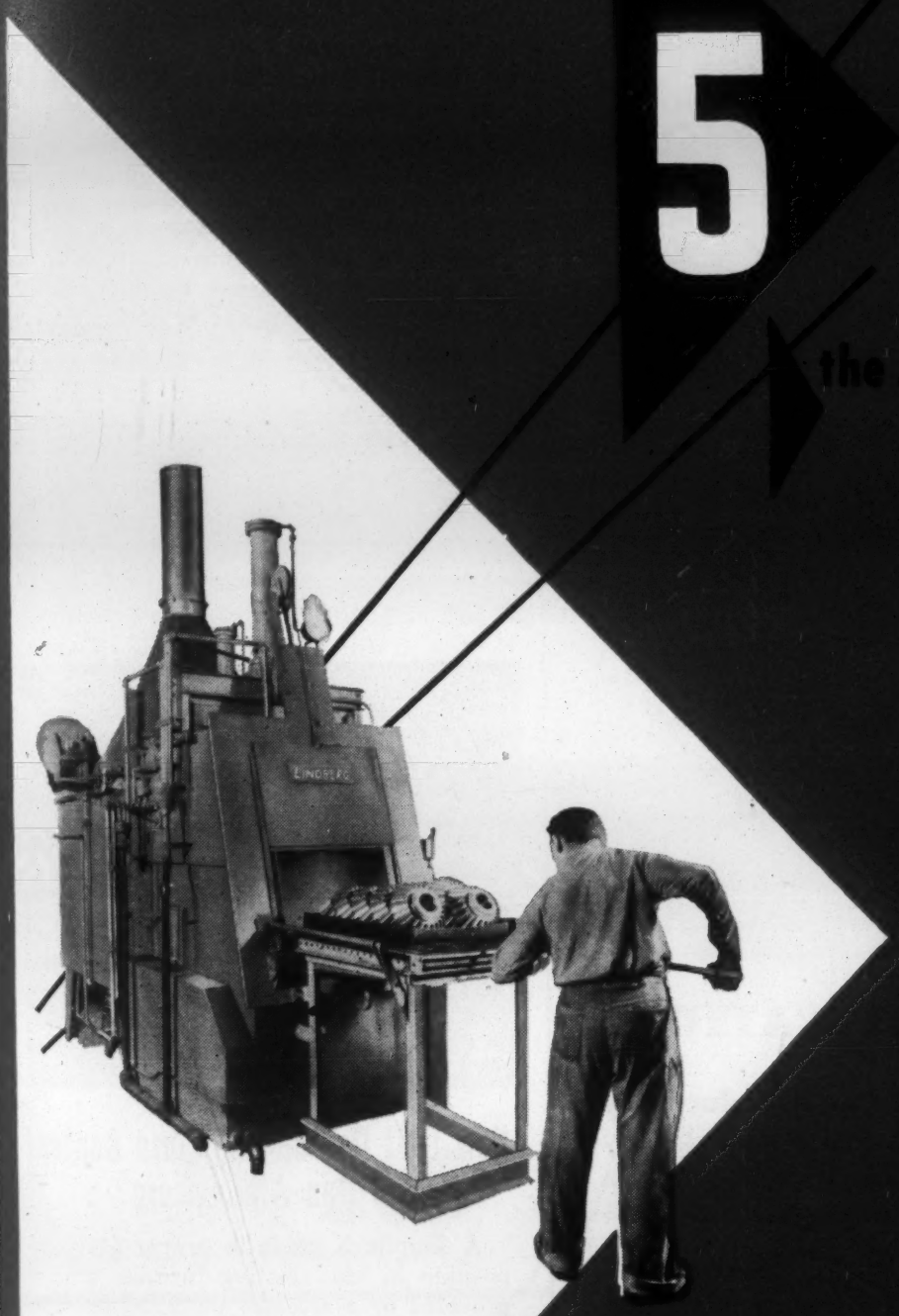
A new line of products now available from *Steelcote Manufacturing Co.*, St. Louis, Mo., under the trade name Steelast, has come out of research work done on stainless steel coating. The formula for Steelast products is basically the same as that of stainless steel coating in that both use a vinyl plastic vehicle; the primary difference being that a change of pigment makes possible the manufacture of all colors including black, white, gray, ivory, green, red orange and yellow.

According to the company, Steelast produces the toughest type of film of any ever tested in its laboratories. It is impervious to moisture, resistant to most chemicals, and is odorless and non-toxic when dry.

The uses in which this coating offers advantages over ordinary coatings are in the protection and finishing of metal surfaces on original equipment, and in the maintenance of machinery, pipes, tanks,

5 FURNACES IN ONE

the *LINDBERG* Carbonitriding Furnace



Yes, it's many furnaces in one! It's designed not only for carbonitriding . . but also for hardening, carburizing and carbon restoration. It's self contained . . it's easy to maintain!

10 reasons why Lindberg Carbonitriding Furnaces are better:

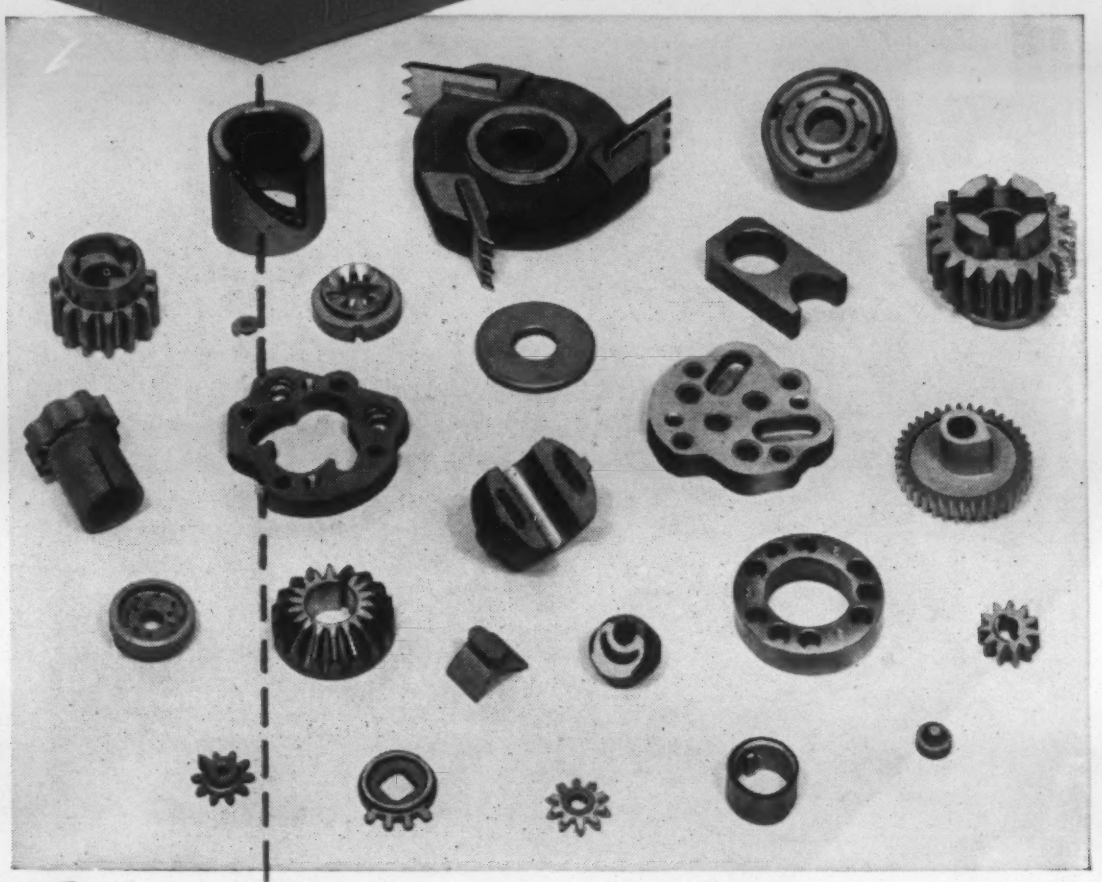
1. Heating is by new type, gas-fired, vertical radiant tubes. They weigh only 29 pounds each . . can be changed in two minutes. Just lift out the old one, and lower the new one in its place.
2. Vertical radiant tubes last longer . . often two or three times as long.
3. Quench tank is built-in . . no costly excavation or piping necessary. Distortion is minimized because quenching takes place within furnace structure, and heated work is never exposed to outside air.
4. Quench tank has fin type oil cooler . . maintains oil at proper temperature for quenching.
5. Specially designed purge chamber purges work loads before they enter heating chamber.
6. Special check-light system tells you where charge is at any given time.
7. Control of heating and quenching cycle is automatic. Uniform case depth is assured because each charge remains at heat same length of time.
8. Depending on your production requirements, Lindberg Carbonitriding Furnaces are made for automatic, semi-automatic, or manual charging.
9. You're not experimenting with Lindberg Carbonitriding Furnaces. They've been tested under three years of rough operating conditions.
10. The famous Lindberg "Hyen" generators which supply atmosphere for Lindberg Carbonitriding Furnaces are instantly adjustable for many different types of atmospheres.

For full details, ask for bulletin #241.

Lindberg Engineering Company

Large or Small... Simple or Intricate

POWDERED METAL PARTS



Exactly TO YOUR SPECIFICATIONS

Illustrated are but a few of the many types of parts produced by Michigan Powdered Metal Products Company. Each has proved highly successful for its specific application . . . and each has made possible substantial savings in the cost of assembled finished products.

As one of the pioneers in the field of powder metallurgy, this company has been responsible for the development of many of the most advanced methods of producing powdered metal parts of all kinds. For example, parts incorporating the Haller Oil-Well principle were developed and are produced exclusively by Michigan Powdered Metal. In the processes employed here, there is the most accurate control of density, porosity, dimensional tolerances and surface finish.

If you are interested in the savings affected by elimination of machining and finishing operations . . . and if you want your specifications to be met *exactly*, it will pay you to learn what we can do for you. Send us your part prints for quotation.

Write for this bulletin describing our facilities and the scope of our powdered metal parts production.

MICHIGAN POWDERED METAL PRODUCTS COMPANY, INC.

476 CADY STREET • NORTHVILLE, MICH.

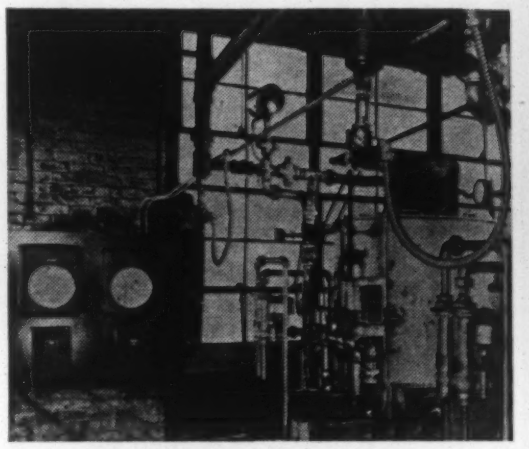
Subsidiary of

ALLIED PRODUCTS CORPORATION

New Materials and Equipment

duct work and metal building materials, indoor and out.

The material can be sprayed, brushed or dipped and it can be applied to rusted or bare unrusted metal after surfaces have been treated, or over painted surfaces that show positive after pretest with primer. The coating will withstand constant wet heat up to 180 F and constant dry heat up to 300 F. It dries to handle in 30 to 60 min. after spraying; 2 to 3 hr after recoating. It can be force dried in 10 min.



New Unit Detects Moisture Content of Gas Atmosphere

A simplified guide to proper gas composition in heat treating furnaces is now provided by a recorder produced by *Foxboro Co.*, Foxboro, Mass, which detects the moisture content of gas atmosphere. The recorder monitors a continuous sample of the gas, permitting the operator to make accurate generator adjustments and hold the moisture content within desired operating limits.

As installed in a number of metal treating plants, the instrumentation consists of a two-pen recorder, a Dewcel power unit and two sensitive elements (dry bulb and Dewcel). A minute flowing sample of gas from the furnace or the exhaust is piped to a sampling chamber where the Dewcel measuring element senses the dew point temperature to within ± 1 C.

A second pen records gas ambient temperatures, which must be roughly within a range related to the dew point measurement. High gas sample temperatures can generally be brought within the working range by lengthening the pipe run between the sampling point and the chamber, or by use of a small cooling water coil heat exchanger.

Key unit in the system is the humidity sensitive Dewcel element which provides a laboratory standard of measurement even in severe industrial service. Ordinary

Here's another new modified polystyrene

MC-305 is the easiest to mold of Koppers "high impact" series of Modified Polystyrenes. It has been used in such large area moldings as refrigerator door liners, air conditioning housings, and television masks and tube protectors.

MC-305's high resistance to shock and impact minimizes danger of damage to molded sections during ordinary production line handling as well as during actual use. Its shock resistant qualities also make MC-305 an excellent material for toys and novelties.

Possibly you have a product that can be made better or faster or less expensively with Koppers Modified Polystyrene. To help you choose the right Koppers material for your particular job, we have prepared a new technical bulletin detailing the properties of Koppers Modified Polystyrenes. Write today for your free copy.

KOPPERS POLYSTYRENES

Type 3	General Purpose Polystyrene
Type 7	Improved Heat Distortion Temperature
Type 8	Highest Heat Distortion Temperature
MC-185	High Impact, Lowest Water Absorption Rate
MC-301	High Impact, Improved Heat Distortion Temperature
MC-305	High Impact, Easy Flow
MC-309	High Impact, Highest Heat Distortion Temperature
MC-401	Medium Impact, Improved Heat Distortion Temperature
MC-405	Medium Impact, Easy Flow
MC-409	Medium Impact, Highest Heat Distortion Temperature

Koppers Plastics Make Many Products Better and Many Better Products Possible.

KOPPERS®

Koppers Plastics

Guaranteed by Good Housekeeping

KOPPERS COMPANY, INC., Chemical Division, Dept. MM-73, PITTSBURGH 19, PENNSYLVANIA

SALES OFFICES: NEW YORK • BOSTON • PHILADELPHIA • CHICAGO • DETROIT • LOS ANGELES

FIND OUT ABOUT **IRIDITE** TODAY for finishing ZINC, CADMIUM, ALUMINUM, CUPROUS METALS

WANT CORROSION RESISTANCE? Iridite will give you better-than-specification protection against corrosion.

WANT PAINT ADHERENCE? Iridite provides a firm and lasting base for paint by preventing under-film corrosion.

WANT EYE-APPEAL? Iridite can give you a variety of finishes, depending upon the metal being finished . . . from clear and sparkling bright or military olive drab, to attractive dyed colors.

BEST OF ALL, any Iridite finish is economical and easy to apply.

for example: **IRIDITE** (AL-COAT) REDUCES NEED FOR ANODIZING

Simple chemical dip; immersion time only 10 seconds to 2 minutes; no sealing dip; color is clear or yellow depending upon your requirements; salt spray resistance equivalent to 20 to 30 minutes of anodizing, eliminates need for costly racks and electrical power.

WANT TO KNOW MORE? Write for literature and send production samples for free test processing. See "Plating Supplies" in your classified telephone directory or write direct.

Iridite is approved under government specifications.

ALLIED RESEARCH PRODUCTS
INCORPORATED
4004-06 E. MONUMENT STREET • BALTIMORE 5, MD.

Manufacturers of Iridite Finishes
for Corrosion Protection and Paint Systems on Non-Ferrous Metals; ARP Plating Brighteners

New Materials and Equipment

dust and contamination have no effect on its operation. It provides a continuous record in dew point; responds rapidly to changes in moisture content.

New, Easy Operating Electrode Offered

A new, easy operating, mild steel E-6010 Electrode, Fleetweld 51, has been put on the market by *The Lincoln Electric Co.*, Cleveland 17. It is a shielded arc electrode designed for all position welding with d.c.

The new electrode is said to be well suited for welding all types of joints in the overhead or vertical position. It is especially well suited for vertical up welding. It produces flat faced fillets when welded in a vertical position and reduces sagging or excessive convexity on welds made in any position.

Fleetweld 51 can also be used with excellent results for welding galvanized, dirty or rusty plate; welding pipe in all positions with vertical up techniques; applications requiring maximum penetration and applications requiring physical properties of an E-6010 type electrode. A deep penetrating electrode, it is available in 14 in. lengths and in 1/8, 5/32, and 3/16 dia. sizes.

Cost Cutting, Hard Surfacing Electrodes Offered

McKay Co., 307 McKay Bldg., Pittsburgh 22, is currently offering a completely new line of cost cutting, hard surfacing electrodes. These electrodes are coated with a newly develped low hydrogen type coating which permits easy operation on both alternating and direct currents. Use of the low hydrogen coatings is said to assure the highest possible quality in deposited weld metal, and at the same time keep weld metal dilution at an absolute minimum providing the proper alloy balance on the working surface.

The electrodes are packaged in hermetically sealed, moisture-proof containers to protect the coatings from moisture pick-up during shipment and storage. Unit containers carry a net weight of ten pounds; a standard shipping carton consists of six unit containers.

McKay Hardalloy is the trade name under which the nine distinctively different grades of hard surfacing electrodes are being marketed.

Floats, fenders and surfboard by Sponge Rubber Products Co., Shelton, Conn.

100% Marvinol–it floats!

It's exploded Marvinol vinyl—just about the biggest thing since the birch bark canoe!

More buoyant than cork! Made into flutter boards, floats, life preservers, and boat fenders, Marvinol cellular plastic *stays* buoyant, too—with practically no absorption!

Almost indestructible! Flattened like a pancake—this tough Marvinol material resumes its original form! It *needs no* coating or finishing—resists abrasion, snagging, tearing—lasts for years and years!

No rot, fungus, or corrosion! Chemically inert Marvinol is impervious to water, oil, or sea growth!

Soft and pleasant to the touch, this material is still firm and easy to handle. And color is lasting—won't bleach, rub off, or mar other surfaces.

Worth going to sea, all right! With its chemical resistance, toughness, and resilience—its heat, light, and color stability—and its ease of processing, Marvinol exploded vinyl has opened a whole new field of product possibilities. Panel thermal insulation, flotation equipment, seals and gaskets, cushioning, and crash panelling are a few of the many.

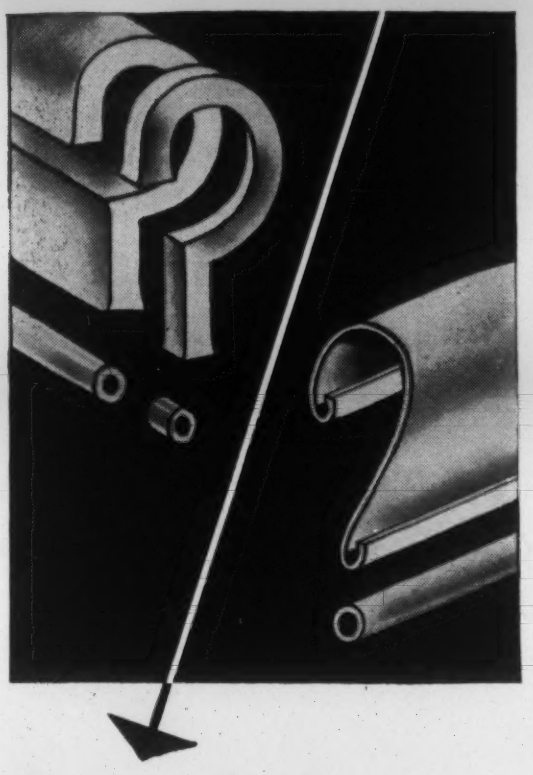
Better look into the pluses Marvinol® offers *you*. For more information on this partner to Naugatuck's VIBRIN® polyesters and KRALASTIC® rubber-resins, write to address below.

Naugatuck Chemical 44 ELM STREET NAUGATUCK, CONNECTICUT

Division of United States Rubber Company

BRANCHES: Akron • Boston • Charlotte • Chicago • Los Angeles • Memphis • New York • Philadelphia

IN CANADA: Naugatuck Chemicals, Elmira, Ontario



Extruded or Roll Formed?

WERNER CAN PRODUCE IT

and Heat Treat—too

in T4—T6 Tempers

IN	VOLUME
TO	PRECISION
WITH	SERVICE

Here's one source for your extruded or roll formed requirements that will back you up with all the service you need. Over 100,000 feet of floor area . . . 30 years of experience and millions of feet of custom extruded and roll formed sections make Werner a reliable, resourceful and skilled supplier.

Secondary operations also available . . . Anodizing, Cutting, Punching, Bending, Welding, Polishing, Assembly.

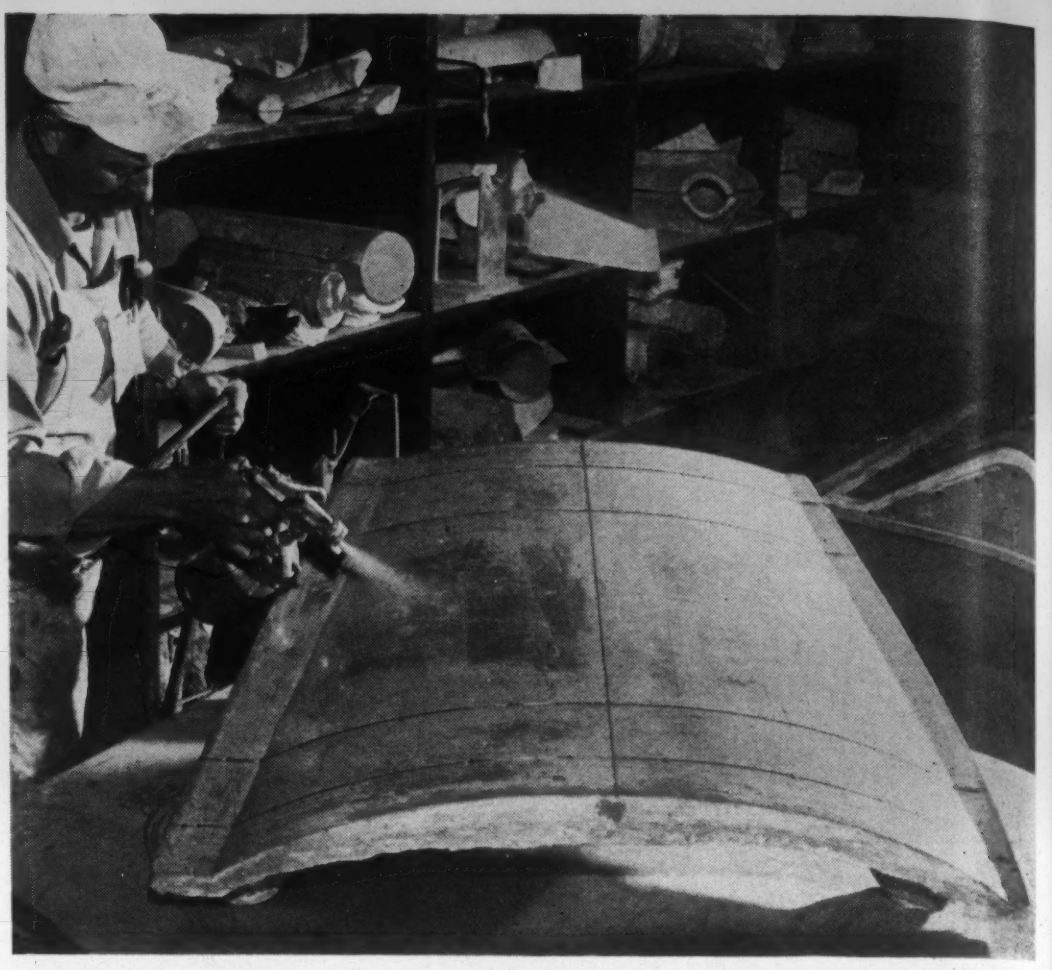
Here are a few of the many products on which Werner shapes are used . . .

ELECTRICAL FIXTURES	TRAILERS, TRUCKS AND BUSES	TV ANTENNA TUBING & MASTS
STORM DOORS AND WINDOWS	RAILWAY COACHES	FURNITURE
SLIDING DOOR HARDWARE	AIRCRAFT	APPLIANCES

Whatever your product or your problem, call Werner—sales representatives are located in all principal cities — or **WRITE** for facilities folder today. **R. D. Werner Company, Inc., Dept. 3307, 295 Fifth Avenue, New York 16, New York.** Factories: Greenville, Pa.; Oshawa, Ontario, Can.

Werner ALUMINUM

Custom Extrusion and Roll Forming
Aluminum or Stainless Steel



Large plaster articles can be effectively impregnated by rapidly applying several coats of a catalyzed furan resin.

Furan Resin Impregnants for Plaster

by JOHN STARR

Service life of inexpensive plaster molds, dies and fixtures, as well as consumer products, can be increased by this furan resin coating compound.

● PLASTER OF PARIS and related types of gypsum compounds have been for many years among the least expensive materials that can be purchased and fabricated for many industrial or commercial purposes. But their use is limited in many respects by the low mechanical strength and poor chemical inertness of articles made from them.

The use of a furan resin coating compound, however, enables the cheapest plaster castings to attain the strength and durability of wood and cast-plastic products without an objectionable increase in cost. This coating is a thermosetting monomer prior to use, and has been tradenamed Plaspreg by Furane Plastics and Chemicals Co., Glendale, Calif.

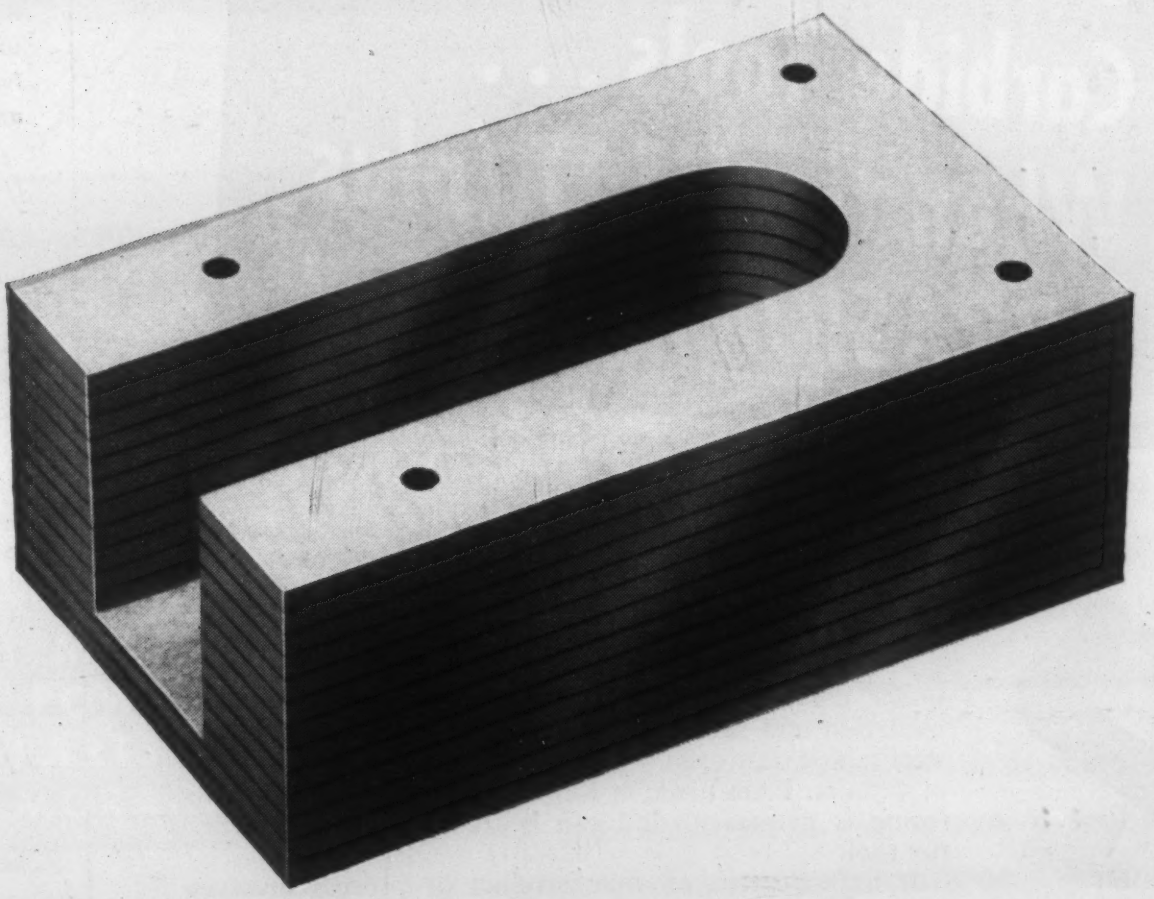
Three grades of Plaspreg are now being manufactured, and each can be distinguished from other polymerizable resins to the extent that it is an extremely fluid substance containing no volatile solvents. This distinction is important because it means that the resinous monomers can deeply penetrate porous materials, whereas the resins in other saturated or unsaturated coatings are

(Continued on page 142)

TAYLOR *Built-up Vulcanized Fibre*
is a new material made of many plies of homogeneous vulcanized fibre bonded together with a special resin developed in Taylor Laboratories. It can be machined with the same facility as homogeneous fibre, has high dielectric strength and is available in any thickness desired. Can be furnished in various colors.

Want to make something of it?

Make it into many products that require physical and electrical qualities that are equal to, or better than, that of the equivalent thickness of homogeneous fibre. The arc resistance at the adhesive line is equal to that of the fibre itself. The adhesive is unaffected by abrupt changes in relative humidity. It gives built-up fibre greater stability . . . resistance to distortion caused by atmospheric conditions. Edge splitting tests have proven the adhesive stronger than the fibre.



Make it from 45″ x 56″ sheets in any thickness desired. The thickness of individual plies can be varied to suit your particular requirements.

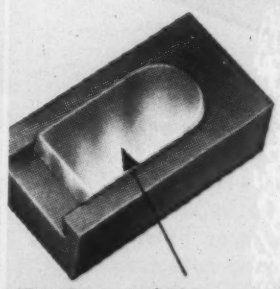
Make sure you get complete information on this versatile new material. Call your Taylor engineer . . . he will be glad to work with you . . . see where it can fit into your products. Let him go over your requirements for laminated plastics also. He may be able to suggest ways that *Taylor Phenol, Melamine and Silicone Laminated Plastics* can do a better job . . . lower your costs.

Taylor Fibre Co., Norristown, Pennsylvania—La Verne, California

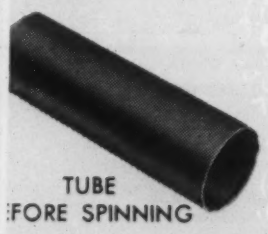
TAYLOR
Laminated Plastics
Vulcanized Fibre

Outlasts 30 Tungsten Carbide Tools . . . When the HEAT (plus ABRASION) . . is On!

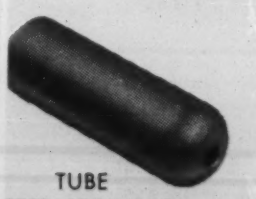
What's Your HOT Design Problem?



NTANIUM INSERT



TUBE
FORE SPINNING



TUBE
FTER SPINNING

This is a typical example of how industry effectively uses heat-resistant Kentanium to improve product performance under conditions of high temperature combined with oxidation and severe abrasion. Spinning the ends of hot steel tubing destroyed tungsten carbide tools in an average of 4 hours. Tools made of Kentanium last 15 hours before facing is necessary—and can be refaced up to 8 times per tool.

If improvement of your product or process involves high temperature conditions, especially where abrasion and oxidation are factors, investigate Kentanium. It is our exclusive development—chiefly titanium carbide (small percentages of other refractory metal carbides), with nickel "binder".

Great strength at temperatures up to 2200°F, and extreme resistance to abrasion, oxidation, and thermal shock are Kentanium's combination of features that cannot be obtained in any other known material. Weighs only ⅔ as much as steel; has hardness up to 93 RA; uses neither tungsten nor cobalt.

Kentanium is available in standard extruded shapes, simple molded forms, and intricate designs. Our engineers are available to work with you to apply it effectively to your high temperature problem.

An Exclusive Development of KENNAMETAL® Inc., Latrobe, Pa.

KENTANIUM

HEAT-RESISTANT, HIGH-STRENGTH, LIGHTWEIGHT
CEMENTED TITANIUM CARBIDE

continued from page 140

Although furan impregnants are widely used on plaster artware and novelties, furan-plaster materials have also proved useful in the aircraft industry for tools, such as form blocks and check fixtures.

normally too viscous to impregnate plaster pores to any appreciable extent.

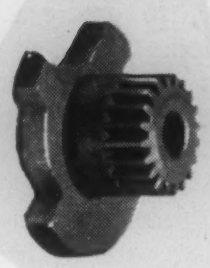
Like most furan resins, Plaspreg compounds have inherently dark colors—ranging from dark brownish-black to light tan or old ivory hues. However, aside from the fact that dark resin colors alone will give plaster casts the appearance of relatively-expensive wood products, several companies have discovered that Plaspreg resins are desirable as impregnation sealants or primers—over which colored lacquers, enamels, etc., can be applied—when plaster articles should have improved physical or chemical properties.

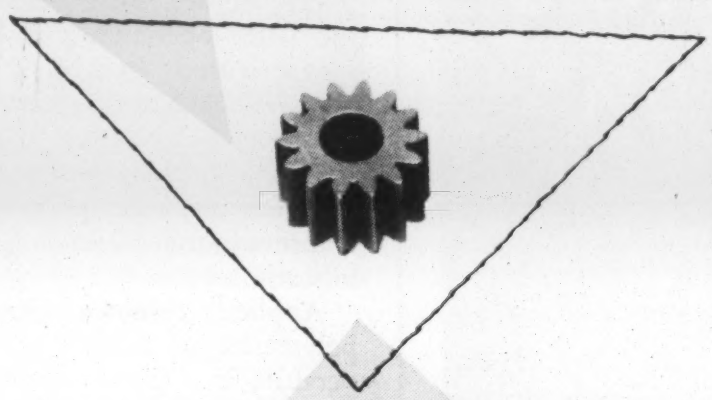
How Impregnant Is Used

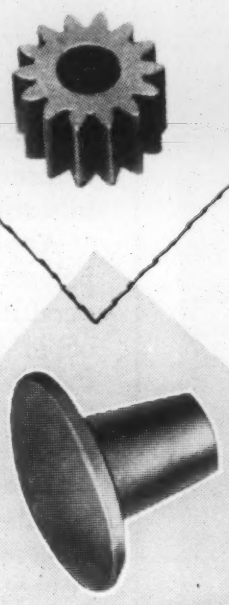
One part acid catalyst is mixed (by weight or by volume) with each five parts of Plaspreg resin immediately before the latter is used, since the addition of the catalyst will inaugurate a polymerization reaction and thus limit the bench life of the resin. However, different catalysts can be employed to provide different bench lifes, ranging from a minimum of two-hours to as much as a week.

As a rule, plaster casts are thoroughly dehydrated prior to use of the catalyzed resin so that the latter will penetrate the porous materials to the optimum extent. Slick spots, due to the use of parting agents in plaster-casting molds, are removed

(Continued on page 146)





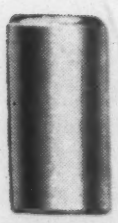


our knowledge began several billion parts ago!

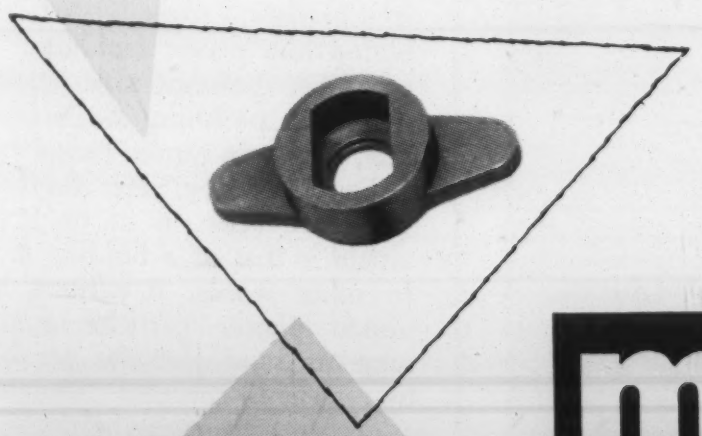
Thirty-two years and several billion parts ago we began learning about powder metallurgy. Our knowledge of this business is now considerable, yet even today there's no end in sight to what can still be learned.

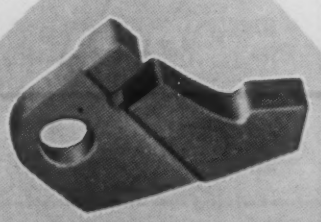
Applying our always-growing knowledge enables us to find new ways to improve the physical properties of our metal powder products; to offer an ever-broadening range of materials to our customers; to make possible more and more applications.

Our position in the field of powder metallurgy is a proud one . . . but we take a greater pride in the fact that our products are providing industry with a means of improving performance while cutting costs.



METAL POWDER PARTS BY MORAINE





m

moraine products

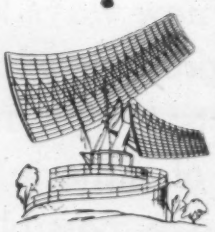
DIVISION OF GENERAL MOTORS CORPORATION, DAYTON, OHIO

TEFLON* CAN *improve your products!*

JOHN CRANE — The best in TEFLON

Exceptional qualities of "JOHN CRANE" TEFLON make it highly desirable for a wide range of equipment and parts lines. Manufacturers of precision equipment and component parts cannot overlook its remarkable electrical, thermal, mechanical and anti-corrosive advantages. Note Teflon's outstanding properties and characteristics.

*DuPont Trade-mark for tetrafluoroethylene resin

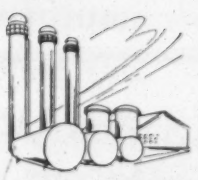


Low power factor high dielectric strength

ELECTRICAL PROPERTIES: Power factor less than 0.0005 over the entire spectrum from 60 cycles to 30,000 megacycles, with a dielectric constant of between 2.00 and 2.05 • Short-time dielectric strengths from 1,000 to 2,000 v., per mil in thickness of 5-12 mils • High resistance to surface arc • Volume resistivity greater than 10^{15} ohm-cm • Surface resistivity drops to only 10^{13} ohms at 100 percent relative humidity.

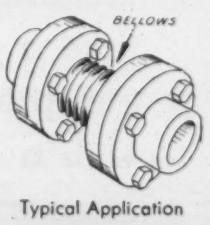
Outstanding thermal characteristics

THERMAL AND MECHANICAL PROPERTIES: Tensile strength 1,500 to 2,500 psi. at 77 deg. F. • Durometer hardness 55 to 70 • Stiffness 60,000 psi. at 77 deg. F. • Friction coefficient against polished steel (static) .09—.12 • Remains flexible down to −94° F. Serviceable up to +482° F.



Corrosion resistant

ANTI-CORROSIVE PROPERTIES: Resists all chemical liquids and gases except molten alkali metals and fluorine and chlorine trifluoride • No detectable changes in properties over 1-year outdoor weather test • Zero water absorption.



Typical Application

TYPICAL APPLICATIONS: For such applications, as vhf, uhf, or high voltage—high temperature insulator forms, heat-resistant linings, oil and firewall seals, gaskets, valve discs or seats, packings, flexible bellows, diaphragms, slot liners, heat sealer jaws and dough rollers. Let our engineers fit "JOHN CRANE" TEFLON to your specific needs.

"JOHN CRANE" TEFLON parts can be manufactured to your specifications. Investigate now. Let us know your requirements. Send for our 12-page illustrated catalog.

Crane Packing Company, 1827 Belle Plaine Ave., Chicago 13, Ill.

JOHN CRANE — CRANE PACKING COMPANY

Furan Resin Impregnants

continued from page 142

by light rubbing with fine sandpaper, when necessary, to assure uniform penetrating action.

Small articles are usually immersed in the catalyzed resin for two or three minutes, but equally good results have been attained in finishing large plaster surfaces by applying to each a rapid sequence of brush or spray coatings. No special spray guns, brushes, etc., are essential to the latter operations; and relatively inexperienced workers can usually apply Plaspreg resins as effectively as the most competent finishers, since the rapid penetration of the furan materials in plaster pores is sufficient to prevent difficulties due to sags or blisters.

Applied resinous coatings will polymerize or solidify at room temperature in a period of several days, or in a period of a few hours if the finished plaster articles are heated to temperatures of 100 to 170 F. Adequate curing temperatures have been attained with infra-red lights and thermostatically controlled ovens (where circulating air was used to assure uniform heating).

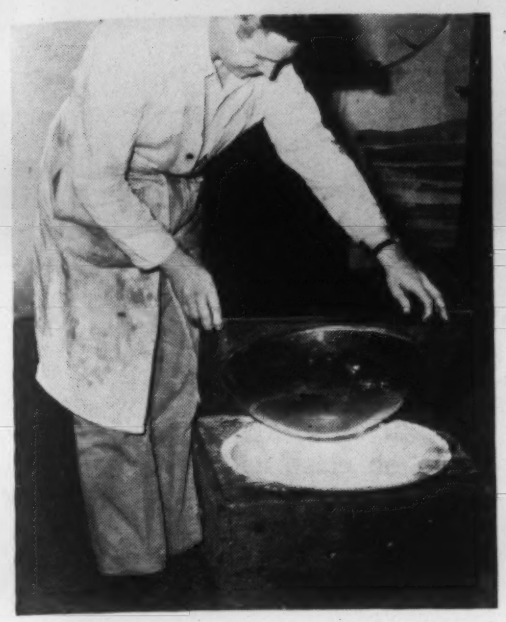
Excessive heating can cause unpolymerized resin to bleed or sweat out of a plaster casting. But, if the sweat is promptly removed with a rag, and if curing temperatures are then regulated for better results, discrepancies due to resin exudations are usually undetectable.

When thoroughly polymerized, a Plaspreg finish has a rather dull and drab appearance. Where special color effects are required lacquers, enamels, etc., can be applied without further surface preparations. Where a natural looking polished-wood finish is specified, treated surfaces are buffed like plastic moldings. Paste-type shoe polishes may be used as buffing or polishing media, if necessary, to attain varied wood hues.

Fundamentally, the function of the furan resin in or on a plaster article is that of a binding medium. In other words, it adheres loosely united plaster particles much the same as sand particles are bonded by cement in concrete. Therefore, if a plaster casting is thoroughly permeated with the polymerized resin, it is difficult to distinguish the finished product from a cast-plastic article (where fillers such as wood flour are often bonded by organic resins).

(Continued on page 147)

continued from page 146



These plate molds for vacuum forming acrylic plastics are impregnated with furan resins.

The use of furan resins in strengthening and finishing plaster products increases the basic cost of raw plaster castings from a level of about 10¢ to approximately 30¢ for each 5 lb of plaster. This increase is not great in view of the fact that most plaster casts require a finish of some kind. As previously intimated, the use of furan-finished plaster products is economically most practical in circumstances that would normally preclude the use of plaster materials.

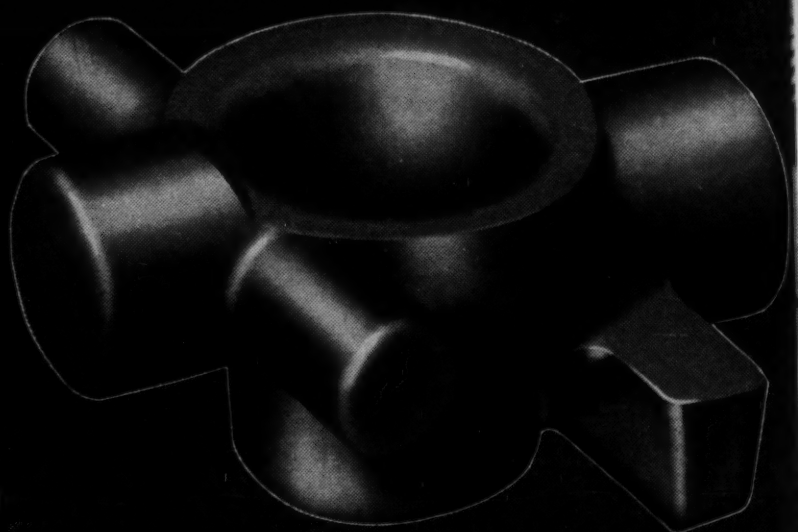
Plaspreg is particularly popular among manufacturers of plaster artware and novelties. However, furan-finished plasters are finding a number of tooling applications which may now be regarded as more important from a practical point of view.

For instance, by using Plaspreg-finished casts in place of conventional phenolic casts (as form blocks, jig or fixture components, molds, dies, etc.), aircraft manufacturers have been able to cut material costs by margins of more than 75% without a sacrifice in the quality of production tools.

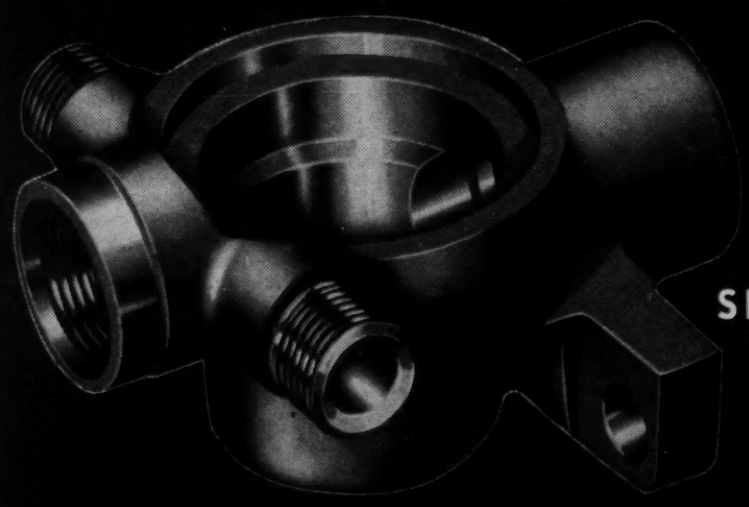
MUELLER BRASS CO.

forgings

BRASS · BRONZE
AND ALUMINUM



FORGED TO
PERFECTION



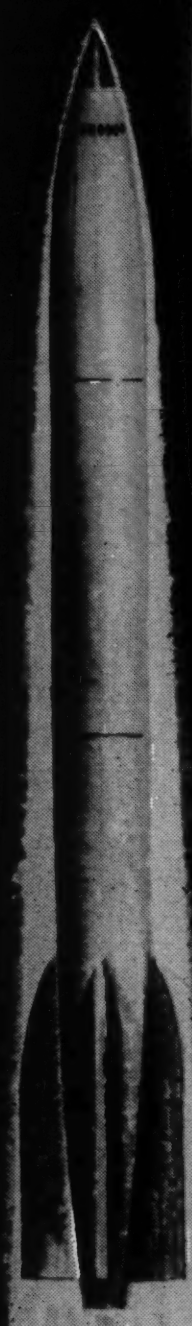
PRECISION
MACHINED
TO YOUR
SPECIFICATION

IT'S YOURS! NEW 32-PAGE
FORGINGS ENGINEERING
MANUAL. WRITE TODAY

MUELLER BRASS CO.
forgings
• brass
• bronze
• aluminum

MUELLER BRASS CO.
PORT HURON · MICHIGAN

New ChemoTec bonding agents

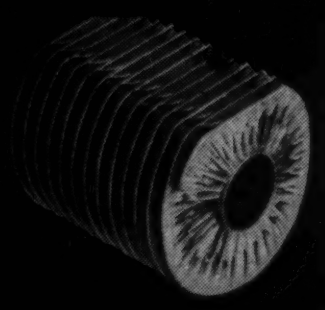


join metal to metal... or metal to non-metals... without heat... without pressure... at low cost!

Now, with these amazing new organic bonding agents, you can join similar metals . . . or dissimilar metals . . . or metals to non-metals . . . quickly, easily—at extremely low heat or no heat at all!

What's more, simple contact-pressure is enough to form a *permanent, porosity-free* bond with tensile strengths exceeding those of many solders! Now you can design and produce — AT LOW COST — such previously "impossible" combinations as:

TITANIUM TO MAGNESIUM TO ALUMINUM • METAL TO GLASS TO CERAMICS • STEEL TO RUBBER TO BRASS • WOOD TO LEATHER TO COPPER — *and scores more!*



The bonding of "fin-tubes" on heat transfer equipment such as this has up to now presented an almost insurmountable metal-joining problem. Today, the extraordinary thin-flowing characteristics of ChemoTec permit it to penetrate to the desired areas by capillary action. Thus, swift and efficient bonding is obtained .. with excellent color match . . . with tensile strength that more than meets specifications . . . at substantial savings in time, labor, and materials!

Tensile strengths exceeding 5000 psi. • Low labor costs • Excellent capillary action • Free flowing Low cost • Heat not essential • No annealing of base metal • Perfect heat control • No galvanic action • No porosity • Pressure not essential Perfect insulation • No corrosion • No flux needed Economical in mass production

CHEMOTEC DIVISION
EUTECTIC WELDING ALLOYS CORPORATION
172nd ST. & NORTHERN BLVD., FLUSHING, N. Y.

FREE

ChemoTec Bonding Agents are available in liquid, paste, powder or rod form to answer every production need. Send for FREE illustrated literature, technical data, etc., to see how these new developments can help solve YOUR joining headaches . . . today!

CHEMOTEC DIVISION MM-7
EUTECTIC WELDING ALLOYS CORPORATION
172nd Street and Northern Blvd., Flushing 58, New York, N.Y.

These new ChemoTec Bonding Agents sound interesting. Without cost or obligation, send me FREE illustrated literature and further information about how they can be adapted to my specific production needs.

Signed.....

Firm.....

Address.....Zone.....

City.....State.....

News Digest

Continuous Wood Panel . . .

continued from page 8

ing process. Thickness can be controlled between 3/16 and ¾ in. and density is controlled between 0.5 and 0.8 or higher.

At a density of 0.7, the top grade of Bartrev board is claimed to have a modulus of rupture of 4500, compressive strength of 2800 and tensile strength of 3100 psi. Effective modulus of elasticity is given as 135 tons per sq in.

The press now operating in England uses over 50 tons daily of normally wasted wood materials, turning out a continuous four-foot panel at speeds up to 30 fpm. The annual production is about 30 million sq ft.

Several Bartrev Presses are now under construction for sale in the United States and Canada through the company's New York representatives Aries Fiberboard Corp.

Studies Continue on Welded Ships

When our tankers and Liberty ships began to fall apart at the seams during World War II, that large part of the public which takes for granted the miracles of present-day technology was somewhat shocked.

So also were most engineers and designers.

Fortunately for morale, the public had other troubles to occupy its attention and it quickly forgot. But embarrassed technologists have been trying to solve the problem ever since.

Causes Isolated

Actually, the causes of these ship failures have been pretty well isolated. The sole controversy, if any, revolves about the relative effectiveness of various suggested remedies.

The two basic facts uncovered in the course of a 10-year investigation are these:

1. The starting point of the ship fractures invariably was a geometrical or metallurgical notch resulting from structural or design details, fabrication processes or welding defects.

2. The plates in which fracture originated had a high transition tem-

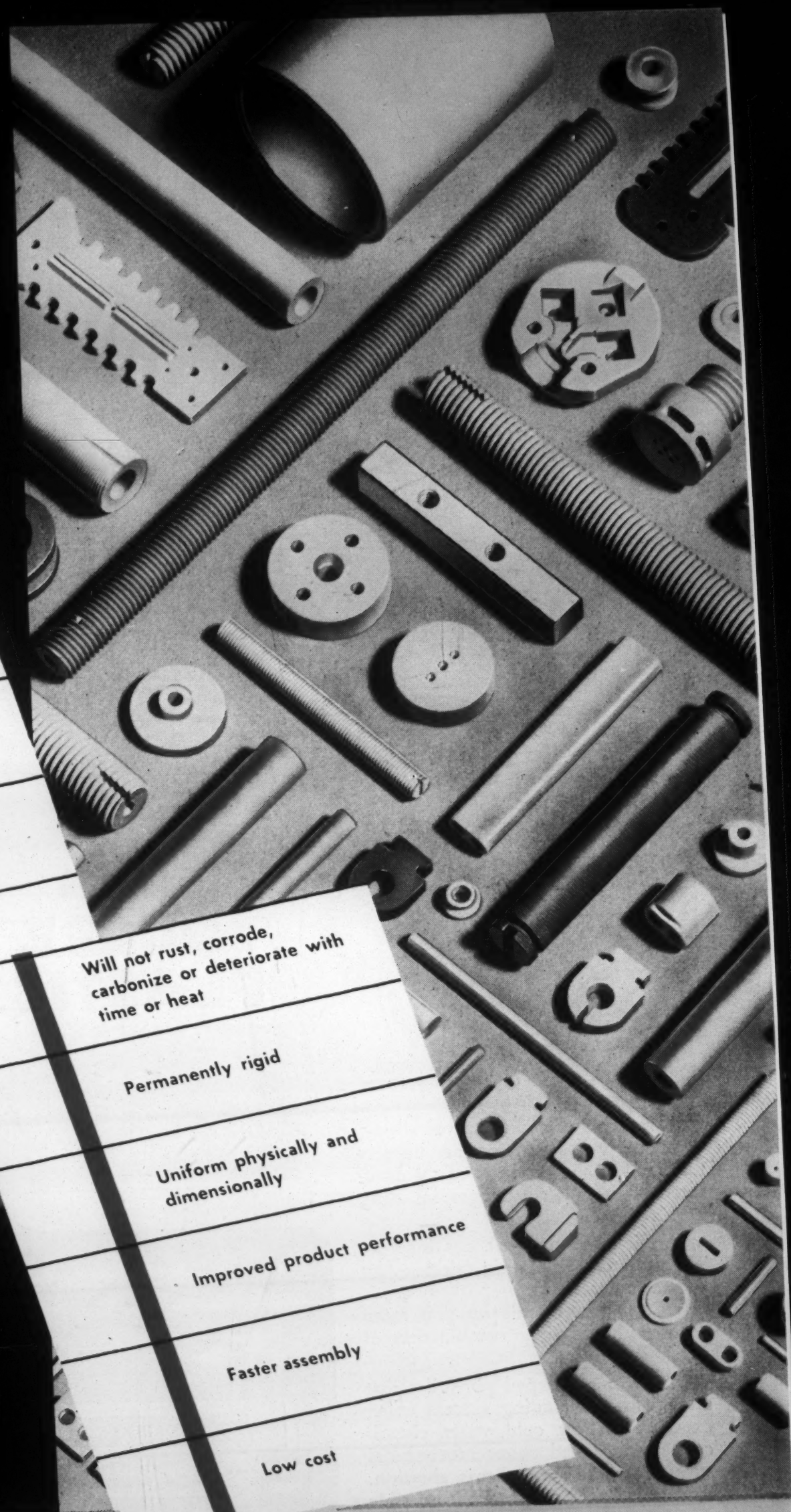
Check these advantages you gain in

AlSiMag®

CUSTOM MADE TECHNICAL CERAMICS

Superior electrical insulation . . . and at high temperatures	
Resistance to heat shock	
Superior hardness and resistance to wear	
Chemically inert	Will not rust, corrode, carbonize or deteriorate with time or heat
	Permanently rigid
	Uniform physically and dimensionally
	Improved product performance
	Faster assembly
	Low cost

In AlSiMag custom made ceramics you have a wide choice of materials to get the characteristics you need. High speed automatic equipment means volume production at low cost. Send blueprint and operating conditions and let us show you what we can do for you.



52ND YEAR OF CERAMIC LEADERSHIP

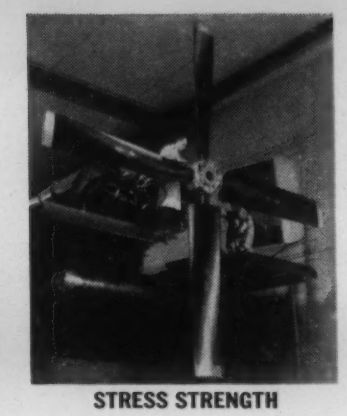
AMERICAN LAVA CORPORATION

CHATTANOOGA 5, TENNESSEE

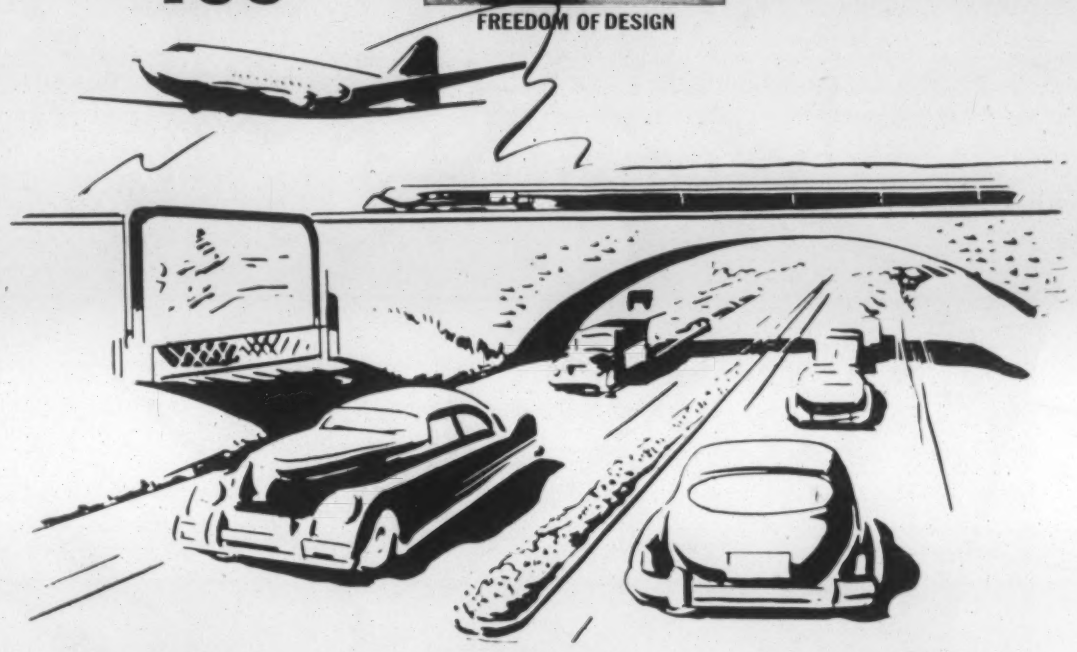
OFFICES: METROPOLITAN AREA: 671 Broad St., Newark, N. J., Mitchell 2-8159 • SYRACUSE, N. Y.: 330 Arlington Ave., Phone 76-5068 • CLEVELAND: 5012 Euclid Ave., Room 2007, Express 1-6685
NEW ENGLAND: 1374 Mass. Ave., Cambridge, Mass., Kirkland 7-4498 • PHILADELPHIA: 1649 N. Broad St., Stevenson 4-2823 • ST. LOUIS: 1123 Washington Ave., Garfield 4959
CHICAGO: 228 N. LaSalle St., Central 6-1721 • SOUTHWEST: John A. Green Co., 6815 Oriole Dr., Dallas 9, Dixon 9918 • LOS ANGELES: 5603 N. Huntington Dr., Capital 1-9114

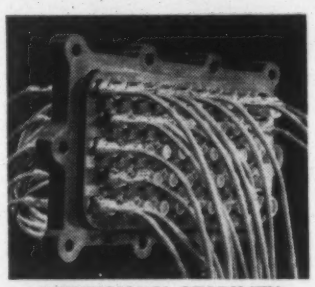
More GO... for your products too

FREEDOM OF DESIGN

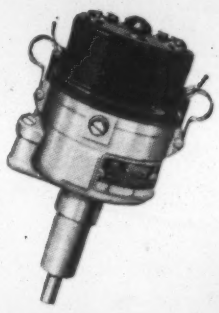


STRESS STRENGTH





DIMENSIONAL STABILITY



ELECTRICAL PROPERTIES

with DUREZ PLASTICS

HEAT RESISTANCE

DUREZ

PHENOLIC RESINS

MOLDING COMPOUNDS

INDUSTRIAL RESINS

PROTECTIVE COATING RESINS

Our monthly "Durez Plastics News" will keep you informed on industry's uses of Durez. Write, on office letterhead.

DUREZ PLASTICS & CHEMICALS, INC.
1407 Walck Road, North Tonawanda, N. Y.

Member S. P. I. Committee on Large Plastics Moldings

●Whatever way you travel today, your safety and comfort are usually furthered by the products of manufacturers who saw advantages in using Durez phenolic plastics.

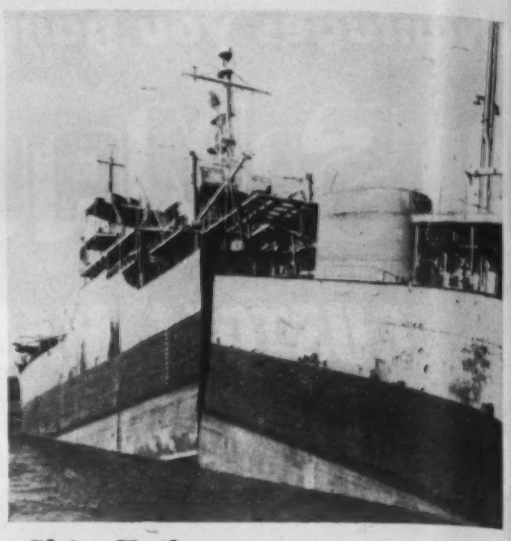
In this there may be a cue for you. The products *you* have in mind . . . for development or for improvement . . . may "go" better and pay you more profit with the right combination of phenolics properties.

We have developed phenolics that serve with outstanding success under exposure to heat, cold, water, chemicals, impact and other mechanical stresses, and in some forms, abrasion. As molded parts they make it possible to cut production corners, step up manufacturing schedules. As resins they protect and often enhance important properties of rubber, wood, and various fabricated substances.

Why not look into the field of phenolics now? Talk with Durez . . . leading specialists in these plastics.

PHENOLIC PLASTICS THAT FIT THE JOB

News Digest



Ship Failure This one occurred at the dock, but many welded ships broke apart at sea.

perature (*i.e.* the temperature at which the steel became "notch sensitive" was of the order of 100 F), and represented the relatively few plates whose notch sensitivity falls in the tail of the probability curve for steels of the quality used when the ships were built.

Some Approaches

A recent report by the National Bureau of Standards indicated some possible approaches to the twin problems of materials and design.

On one hand, studies of loading and stress concentration have led to several suggested changes in design intended to reduce stress concentration at notches. Essentially, these changes have involved either a change in welding technique or an increase in the thickness of the material at that point.

As for the materials themselves, two alternative remedies have been suggested by NBS:

1. Improve the average quality of the steel with respect to notch sensitivity. (In effect, this means move the entire probability curve in the direction of increased notch toughness, so that a much smaller proportion of the plates in the tail of the curve would fall beyond acceptable limits of notch sensitivity.)

2. Determine the notch sensitivity of every heat of steel by inspection tests, and reject all heats which fail to meet suitable prescribed standards. (In effect, cut off the tail of the probability curve.)

In line with the first approach, NBS metallurgists have found that, within the composition range of the ship steels studied, notch sensitivity is increased with increasing amounts

For light metal alloy
and plaster mold castings . . .

SPECIFY

ECLIPSE-PIONEER FOUNDRIES

And be sure of getting . . .

QUALITY

Available from Eclipse-Pioneer are aluminum and magnesium plaster mold castings that meet exacting high standards of precision. You'll find that E-P castings, including those of recently developed Cerium and Zirconium magnesium alloys, require a minimum of machining . . . thus saving you both time and money.

FASTER SERVICE

Our experience of more than twenty years with these specialized types of castings . . . plus the most advanced methods and equipment, including a completely conveyorized production line . . . assure you of getting *what you want when you want it.* And we're continually developing still faster ways of turning out even higher quality castings!

ECLIPSE-PIONEER FOUNDRIES • TETERBORO, N. J. • DIVISION OF

THE NAME Bendix AVIATION CORPORATION MILLIONS TRUST

Export Sales: Bendix International Division, 205 East 42nd. St., New York 17, N. Y.

Precision (± .005") plaster mold castings

Call on us for SAVINGS

Why not let our skilled team of technicians, metallurgists and researchers determine exactly what savings we can make for you? Write today for complete details.

FREE "BOOK OF FACTS"!

Please send me your "Book of Facts" on magnesium and aluminum castings.

Name_____ Title_____

Company_____ Street_____

City_____ Zone____ State_____

Which "High Strength" Do You Want Most In An Aluminum Alloy?

High TENSILE Strength?
High IMPACT Strength?
High ELONGATION?
High BRINELL?

NO!

Most important is HIGH YIELD STRENGTH, for this is the measure of the *useful limit* of a material.

What do you care if a casting of such-and-such an alloy will not rupture until 40,000 psi?

What you want to know is how much the casting can take *before it fails in its job*. And that is told by its YIELD STRENGTH.

Castings made with Federated Tenzaloy will give you yield strengths up to these values:

	As Cast	Aged 10-14 Days At Room Temp.
Sand Cast	16,000 psi	25,000 psi
Permanent Mold	14,000 psi	27,000 psi

And remember, no heat treatment is needed!

These and other outstanding properties have been proved stable for as much as four years.

Full particulars are given in Bulletin No. 103. Graphs, tables, illustrations included. For free copy of bulletin use coupon below.

Federated Metals Division

AMERICAN SMELTING AND REFINING COMPANY
120 BROADWAY, NEW YORK 5, N. Y.
In Canada: Federated Metals Canada, Ltd., Toronto and Montreal

Federated first in the non-ferrous field FMD

☐ Please send Bulletin No. 103 on TENZALOY

☐ Please send a Federated Salesman

NAME _____

COMPANY NAME _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

News Digest

of carbon and phosphorus, and decreased with finer grain size and with increasing amounts of silicon and manganese.

Workmanship a Factor

A third factor, not being studied by the NBS but under investigation elsewhere, is the extent to which workmanship—the work of fitters, welders, supervisors and inspectors—can be controlled to carry out the ideas of the designer.

Much of the knowledge and design data obtained at NBS and other laboratories has already been incorporated into ship construction specifications in an effort to eliminate future failures. It seems unlikely, therefore, that we will ever again suffer an epidemic of welded ship failures such as that which has cost this country some 50 million dollars over the past 10 years.

Strategic Imports: Where We Stand

History has moved so fast in the past two decades that some important milestones have slipped by the American people almost unnoticed. The United States passed one such milestone in 1940. During that year, for the first time, this nation became a net importer of raw materials. By 1950, consumption of raw materials exceeded domestic production by 9%.

Of course, the national government and top industrial leaders recognized the serious potential problems raised by our growing dependency on foreign nations. A stockpile of critical commodities was started as early as 1946.

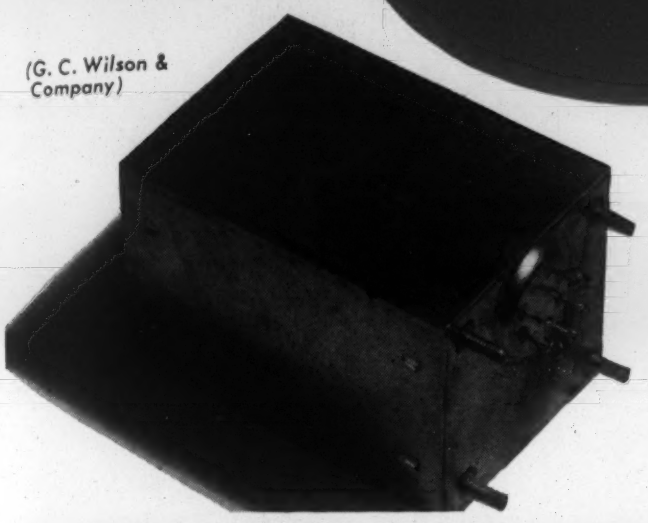
Since then, more than one industry has suffered because of material shortages caused by stockpiling or diversion of critical materials to defense production. But it is safe to say that the full impact of our growing dependency as a nation has never been felt by anywhere near a majority of American fabricators, let alone the consuming public.

In a recent report on this situation, the Defense Production Administration summarized the extent to which we are dependent for 27 strategic raw materials. The following data has

IDEAS *in the making*

Araldite® Bonding, Casting and Coating Resins developed by Ciba Research are simplifying manufacturing methods, improving product efficiency, and opening new fields of product development. You will want to know more about them.

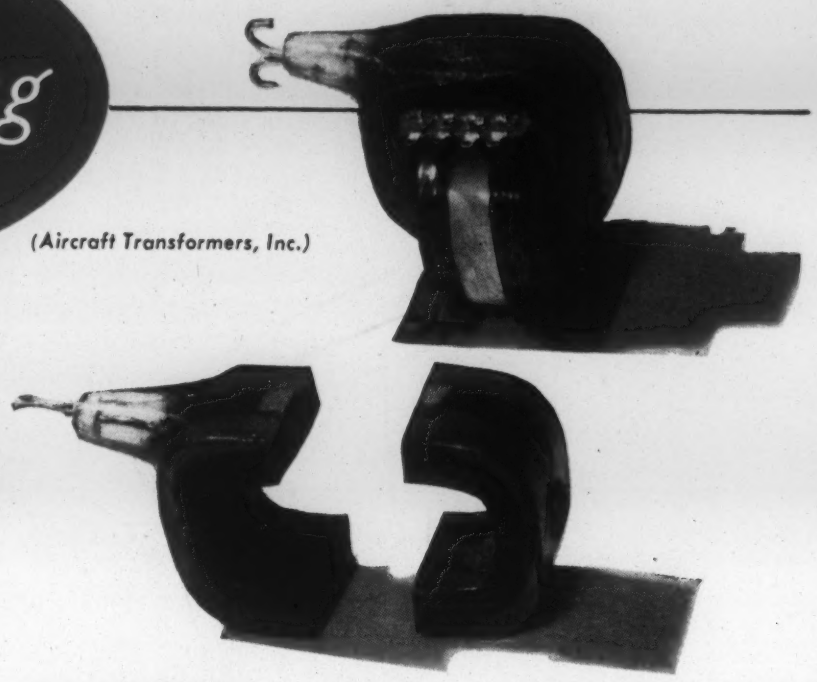
(G. C. Wilson & Company)



ELECTRONIC ASSEMBLY OF AIR-TO-GROUND ROCKET MADE MOISTURE-PROOF AND STRENGTHENED WITH EPOXY COATING RESIN

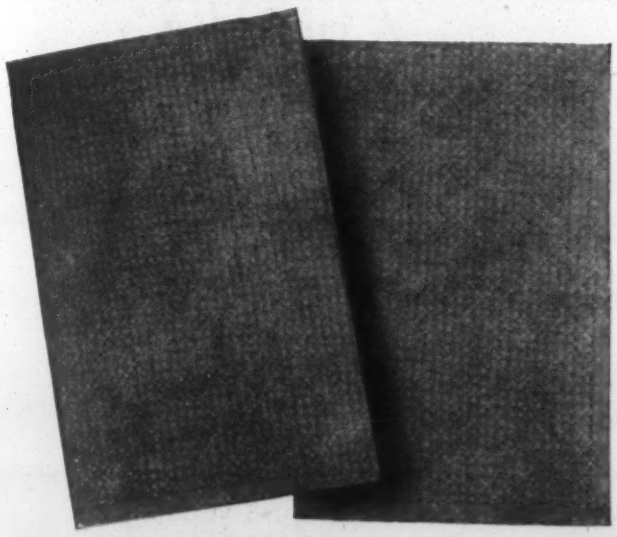
The time-saving simplicity of coating operations combined with the rugged protection afforded by ARALDITE coating resins make applications such as this routine on either a specialized assembly or mass production basis.

(Aircraft Transformers, Inc.)



EPOXY RESIN ENCAPSULATES TRANSFORMER COILS

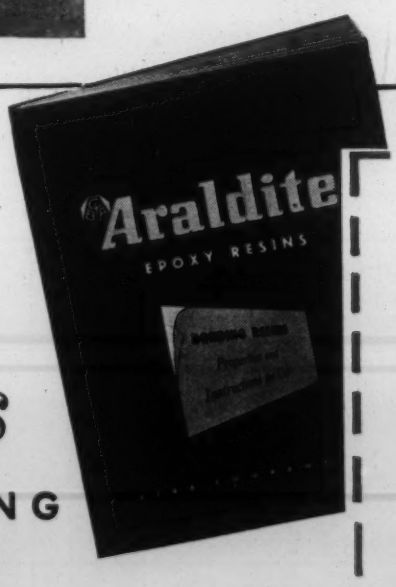
The excellent dielectric properties of ARALDITE epoxy casting resins coupled with high affinity for metals have made them "the resin of choice" among leading electrical and electronic designers and manufacturers for potting and impregnating transformers, capacitators, coils, motor windings and similar apparatus requiring long-lasting efficiency in operation.



EPOXY RESIN PRE-IMPREGNATES GLASS CLOTH

The application of ARALDITE "CN" epoxy impregnating resins by fabricators of glass laminates suggests a wide field of related uses where the low shrinkage, excellent dielectric strength, exceptional resistance to chemical attack and durable adhesive properties provide unprecedented advantages for product "in use" efficiency. ARALDITE impregnating resins are produced in types suitable for either heat-curing or self-curing. ARALDITE is available as pre-impregnated cloth or as cured laminates.

(Cordo Chemical Company)



SEND THIS COUPON . . . or write us on your company letterhead . . . for complete technical data on the physical properties and recommended procedures for the successful use of Araldite Resins for your own fabricating needs.

CIBA *Plastics*

BONDING ★ CASTING
COATING RESINS

CIBA COMPANY, INC., PLASTICS DIVISION
627 Greenwich St., New York 14, N. Y.
(In Canada: Ciba Co. Ltd., Ciba Bldg., Montreal)

Please send me Ciba Plastics Technical Bulletins for

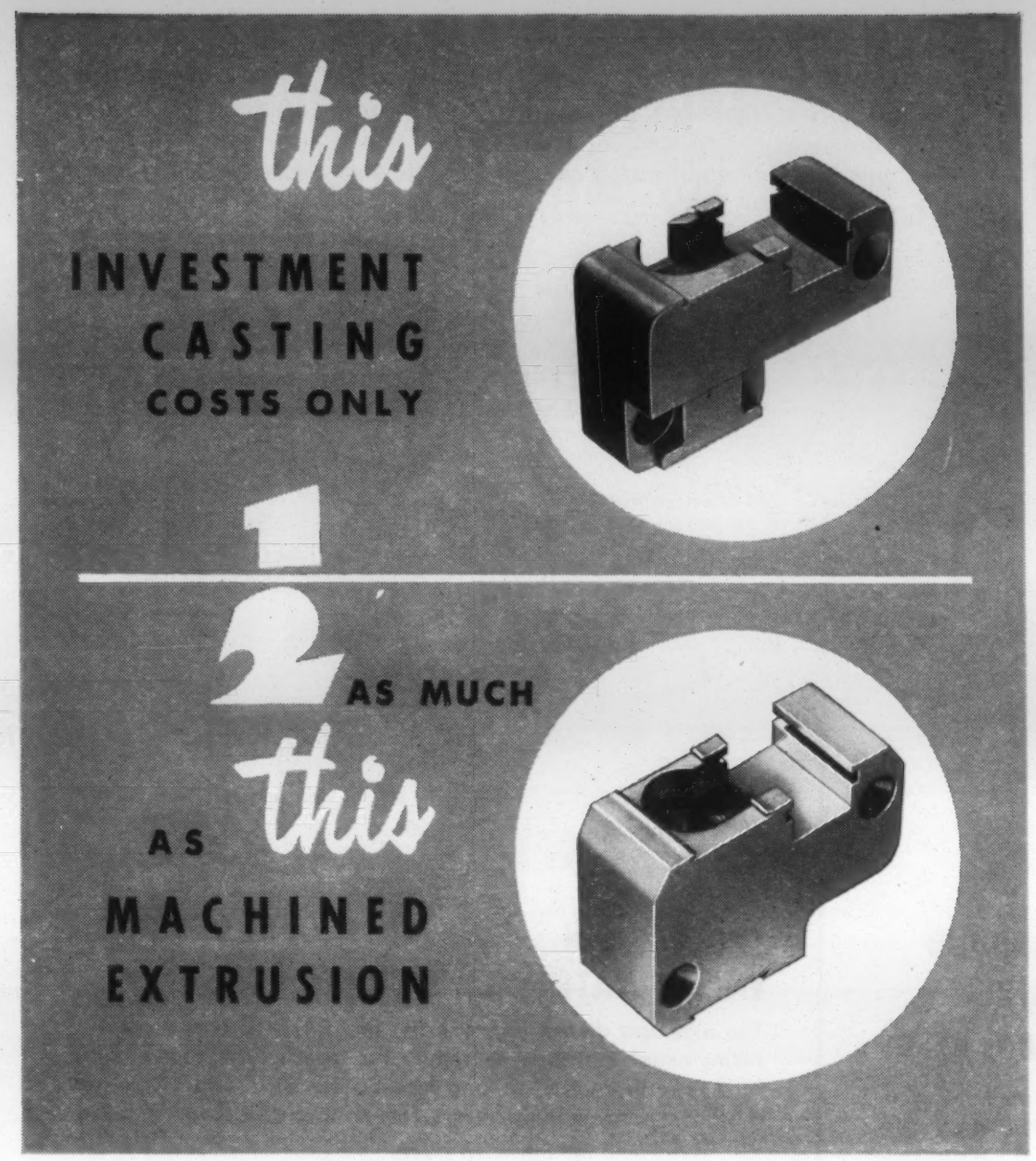
BONDING ☐ CASTING ☐ COATING ☐

*Name*_____

*Company*_____ *Title*_____

*Address*_____

MM-7



General Bronze Corporation, Garden City, N. Y., discovered that this Hitchiner-cast window lock housing gives completely satisfactory performance and eliminates the drilling and boring of a half-inch through hole and the milling of slots and dovetail recesses as well as the drilling and countersinking of mounting and set screw holes. In the investment casting only the set screw hole is drilled and tapped.

Figure it out for yourself what this saving must be and at the same time give thought to how Hitchiner Investment Castings might save you money on components for your product.

One of our technically trained representatives will be glad to discuss your problem or, if you send us drawings and specifications, we'll give you a complete engineering analysis and recommendations without obligation.

If you want your castings finished to print we can supply them through an associate company.

HITCHINER Manufacturing Company, Inc.
MILFORD 3, NEW HAMPSHIRE
Representatives in principal cities.

News Digest

been adapted from the DPA report (the figure in parentheses indicates the extent of our dependency):

Antimony (75%)

Source: Bolivia, Mexico, Union of South Africa, England (oxides).
Main use: Harden lead for storage battery plates, cable sheathing; bearing alloys. Oxide used in enamels, flame-resistant paints, fabrics.
Current supply: Ample.

Asbestos (95%)

Source: Canada, Union of South Africa, Southern Rhodesia, Bolivia.
Main use: Insulation.
Current supply: Inadequate.

Bauxite (65%)

Source: Dutch Guiana, British Guiana, Indonesia.
Main use: Ore of aluminum.
Current supply: Adequate.

Beryl (90%)

Source: South Africa, Brazil, Southern Rhodesia.
Main use: Ore of beryllium (copper alloys). Atomic energy uses.
Current supply: Very tight.

Bismuth (50 to 55%)

Source: Peru, Mexico, Canada, Yugoslavia.
Main use: Low melting alloys; pharmaceuticals.
Current supply: Adequate.

Chromite (99%)

Source: South Africa, Turkey, Philippines, Southern Rhodesia.
Main use: Ferrochrome for alloying steel; refractories; chemicals.
Current supply: Inadequate.

Cobalt (90%)

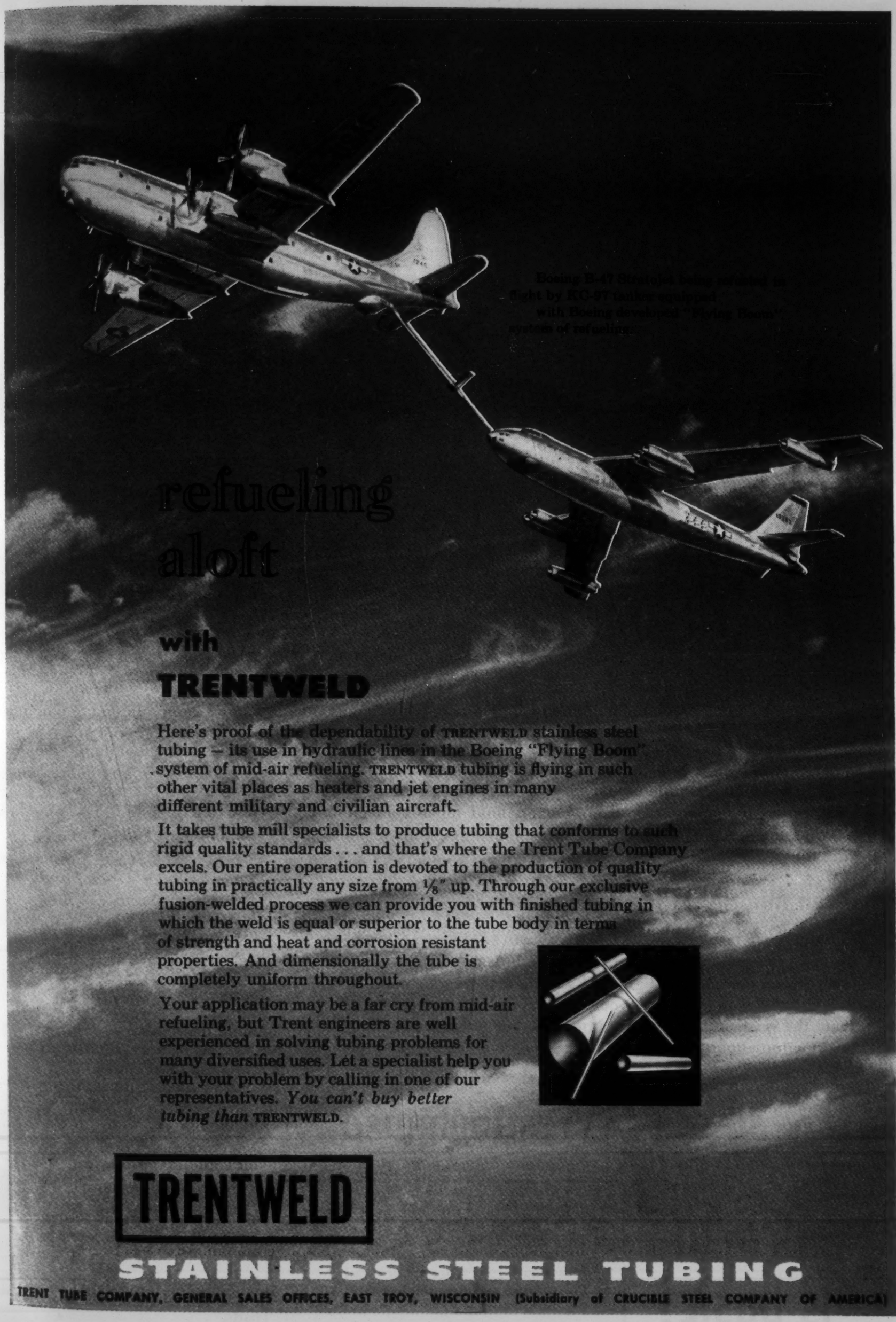
Source: Belgian Congo, Northern Rhodesia, French Morocco, Canada.
Main use: High temperature alloys; magnets, electrical alloys.
Current supply: Very short.

Columbium (100%)

Source: Nigeria.
Main use: High temperature alloys.
Current supply: Scarcest of all alloying metals.

Copper (35%)

Source: Chile, Mexico, Canada.
Main use: Extremely broad.
Current supply: Inadequate.



Boeing B-47 Stratojet being refueled in flight by KC-97 tanker equipped with Boeing developed "Flying Boom" system of refueling.

Here's proof of the dependability of TRENTWELD stainless steel tubing — its use in hydraulic lines in the Boeing "Flying Boom" system of mid-air refueling. TRENTWELD tubing is flying in such other vital places as heaters and jet engines in many different military and civilian aircraft.

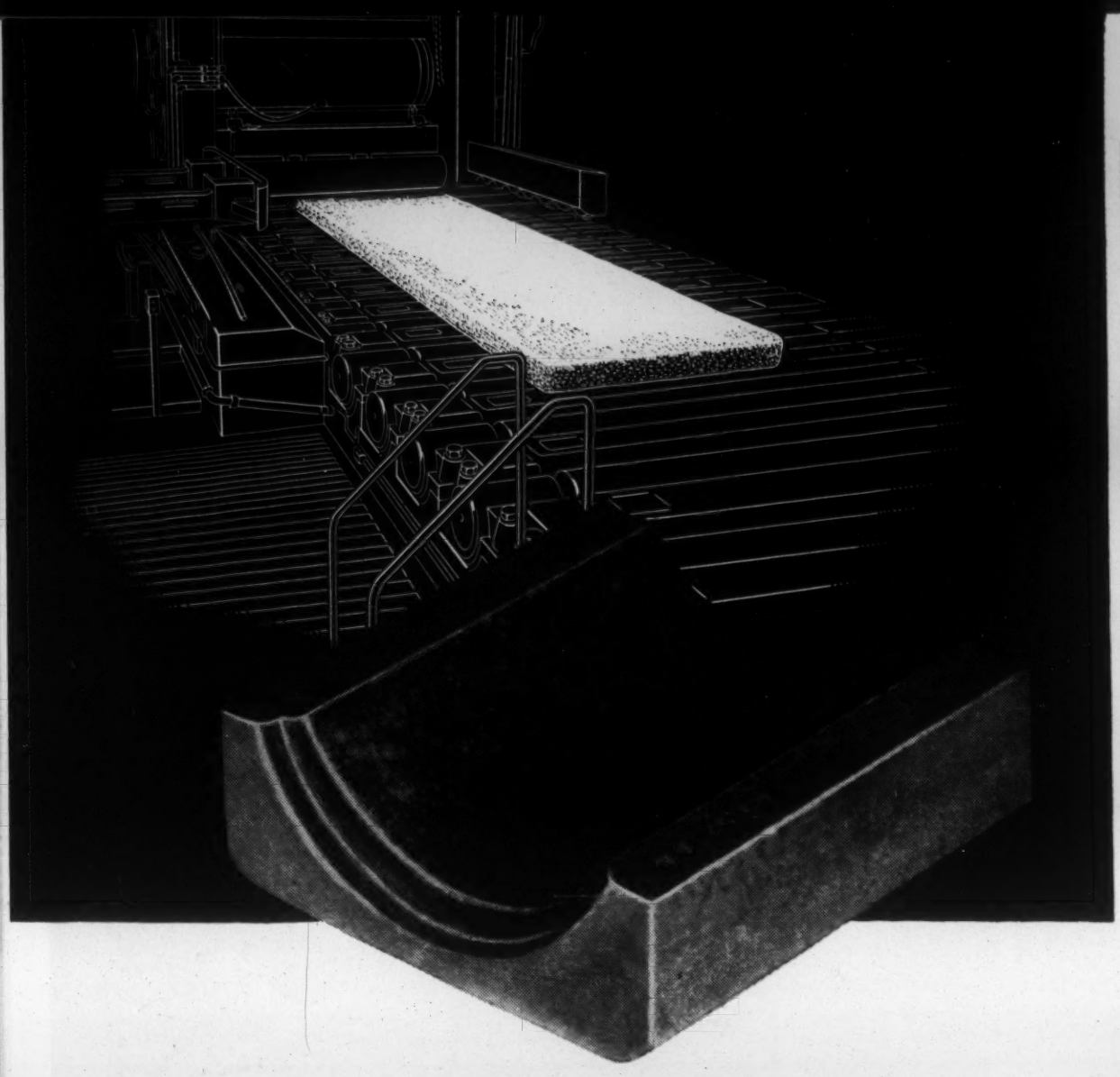
It takes tube mill specialists to produce tubing that conforms to such rigid quality standards . . . and that's where the Trent Tube Company excels. Our entire operation is devoted to the production of quality tubing in practically any size from ⅛" up. Through our exclusive fusion-welded process we can provide you with finished tubing in which the weld is equal or superior to the tube body in terms of strength and heat and corrosion resistant properties. And dimensionally the tube is completely uniform throughout.

Your application may be a far cry from mid-air refueling, but Trent engineers are well experienced in solving tubing problems for many diversified uses. Let a specialist help you with your problem by calling in one of our representatives. *You can't buy better tubing than* TRENTWELD.

TRENTWELD

STAINLESS STEEL TUBING

TRENT TUBE COMPANY, GENERAL SALES OFFICES, EAST TROY, WISCONSIN (Subsidiary of CRUCIBLE STEEL COMPANY OF AMERICA)



Here's what micarta®
LAMINATED PLASTICS

is doing for steel production!

A leading steel producer wanted a roll-neck bearing material that could cut power costs, increase tonnage and hold more accurate gauge. Now, thousands of MICARTA roll-neck bearings are performing efficiently in steel mills throughout the country.

What can Micarta do for you?

Your problem may be as simple as noise control or electrical insulation. Perhaps you need a material that resists moisture, that is lubricated with water, that is both light and strong, that wears smoothly, slowly. Whatever your problem, your industry, or your application investigate the qualities of versatile MICARTA. For prompt and complete information about MICARTA fill out the coupon below.

YOU CAN BE SURE...IF IT'S Westinghouse

micarta® is basic!

Westinghouse Electric Corporation
MICARTA Division, Trafford, Pa.
Attention: L. A. Podley
Sir: (Please check one)
☐ Please have your representative call
☐ Please send me the complete facts on MICARTA

Name_____ Company_____

Address_____

City_____ Zone___ State_____

J-06512

News Digest

Fluorspar (35%)
Source: Canada, Germany, Mexico, Spain.
Main use: Glass, enamel; hydrofluoric acid; steel production.
Current supply: Adequate.

Ilmenite (32%)
Source: India, Norway.
Main use: Ore of titanium; pigments.
Current supply: Adequate.

Industrial Diamonds (100%)
Source: Belgian Congo, French West Africa, Gold Coast.
Main use: Tools, dies, grinding wheels.
Current supply: Almost adequate.

Iron Ore (8%)
Source: Chile, Sweden, Canada, Brazil, Algeria.
Main use: Ore of iron and steel.
Curent supply: Ample.

Jewel Bearings (90%)
Source: Switzerland.
Main use: Timepieces; precision gages, tools.
Current supply: Adequate.

Lead (45%)
Source: Mexico, Canada, Peru, Yugoslavia.
Main use: Broad.
Current supply: Adequate.

Manganese (90%)
Source: India, Gold Coast, Cuba, Union of South Africa, French Morocco, Mexico.
Main use: Steel production.
Current supply: Adequate.

Mercury (90%)
Source: Spain, Italy, Yugoslavia, Mexico.
Main use: Electrical apparatus, special instruments; pharmaceuticals; chemicals manufacture.
Current supply: Adequate.

Mica (95%)
Source: India Brazil (muscovite), Madagascar, Canada (phlogopite).
Main use: Electrical components, insulation.
Current supply: Barely adequate.

Nickel (99%)
Source: Canada.
Main use: Alloying steel; electrical parts.

an ACCO product

J-Model "Rockwell" Hardness Tester used to check surface hardness of gear teeth

How "ROCKWELL"* Hardness Testers Reduce Customer Complaints

• Surface hardening of wearing parts makes them last longer but it is a job requiring skill and precision. The eye cannot detect inaccuracies but a WILSON "ROCKWELL" hardness test leaves nothing to chance.

The WILSON "ROCKWELL" Hardness Tester is a precision instrument with totally enclosed "Zerominder" dial, gripsel clamp screw for quick change and proper seating of penetrator, conveniently grouped controls, enclosed variable speed dash pot, and standardized weights.

Regular and Superficial WILSON "ROCKWELL" Hardness Testers come in many styles with accessories for testing flats, rods, rounds, odd shapes.

There is the WILSON TUKON for micro-indentation hardness testing.

Write for literature.

Trade Mark Registered

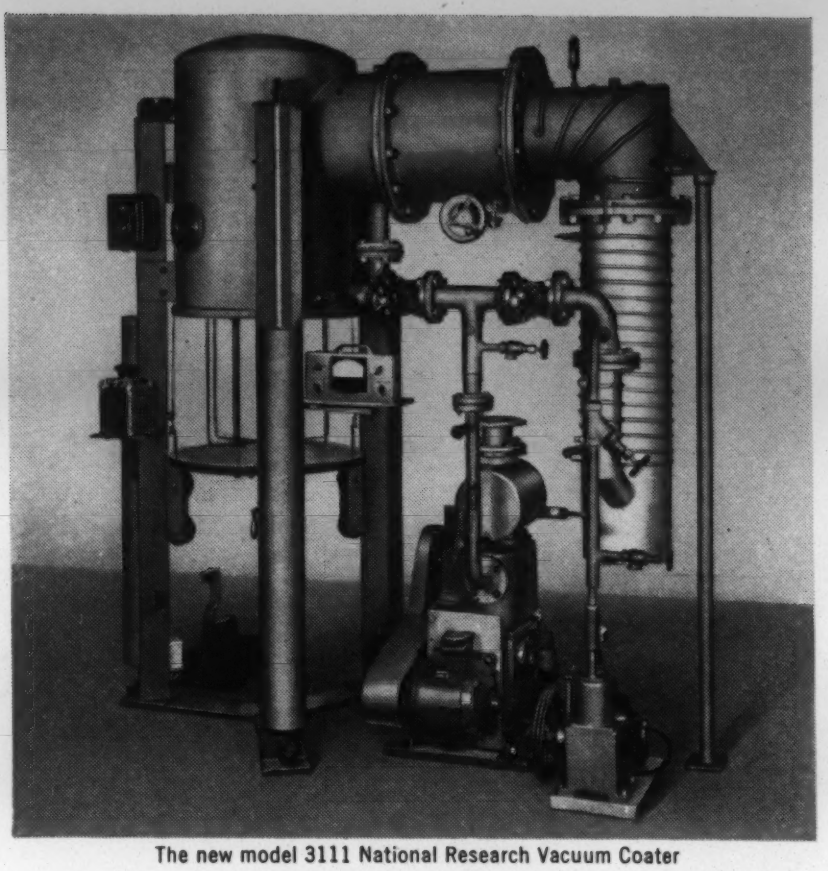
ACCO

TRADE MARK

WILSON MECHANICAL INSTRUMENT DIVISION
AMERICAN CHAIN & CABLE

230-E Park Avenue, New York 17, N. Y.

WILSON "ROCKWELL" and TUKON Hardness Testers



The new model 3111 National Research Vacuum Coater

VACUUM COATER

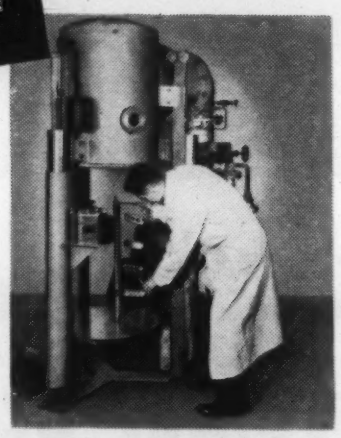
$6350* for medium production

COMPLETE — READY TO OPERATE

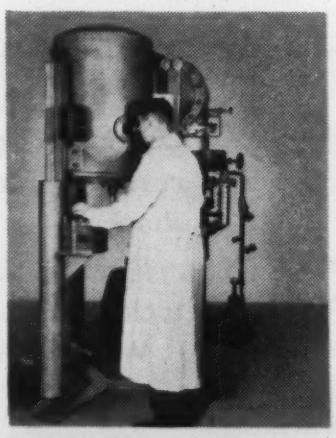
If your vacuum metallizing production has outgrown the bell-jar stage, here's your answer. A new, low cost coating unit complete with Alphatron® gauging, jigs with manual rotator and filament power supply. It swiftly coats plastics or metal surfaces with a gleaming layer of metal.

Simple to operate. All loading, unloading and operating is done at a single station. Equipped with NRC Rotary Gas Ballast Pumps that maintain initial cfm rate even when pumping water vapor, plus a 10-inch diffusion pump. Pump down time to coating pressure is approximately 4 to 5 minutes with the tank dry and empty. Tank size 24 inches in diameter, 30 inches high. Write for details.

*F. O.B. Newton, Mass.



Loading and unloading the racks



Operating the coater

INDUSTRIAL RESEARCH
CHEMISTRY, METALLURGY
HIGH VACUUM ENGINEERING

NRC

PROCESS DEVELOPMENT
PHYSICS, DEHYDRATION
DISTILLATION, VACUUM COATING

National Research Corporation
EQUIPMENT DIVISION
Seventy Memorial Drive, Cambridge, Mass.

News Digest

Current supply: Inadequate.

Platinum Group (90%)

Source: Canada, Colombia, South Africa.
Main use: Chemical, electrical industries; dental, medical purposes.
Current supply: Adequate.

Quartz Crystals (100%)

Source: Brazil.
Main use: Electronics, optical equipment.
Current supply: Adequate.

Natural Rubber (100%)

Source: Malaya, Indonesia, Thailand.
Main use: Broad.
Current supply: Adequate.

Rutile (31%)

Source: Australia.
Main use: Ore of titanium. Manufacture of welding rod coatings, glass fiber, chemicals; pigments for ceramics.
Current supply: Adequate.

Selenium (34%)

Source: Canada.
Main use: Glass, rubber, pigment, electronics industries.
Current supply: Inadequate.

Tin (100%)

Source: Malaya, Indonesia, Bolivia, Belgian Congo, Thailand, Nigeria.
Main use: Broad. Tinplate, solder, brass and bronze.
Current supply: Inadequate.

Tungsten (52%)

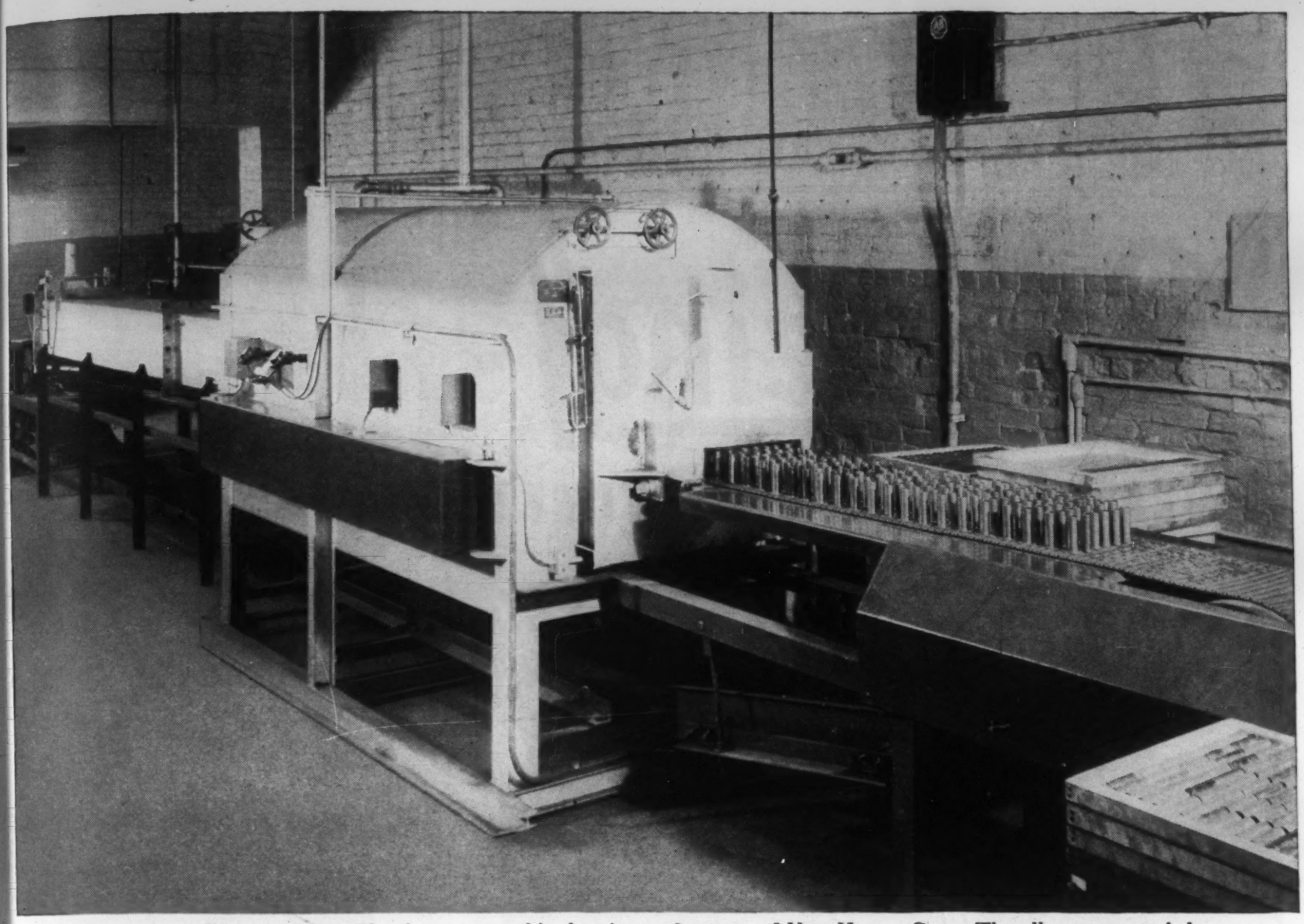
Source: Bolivia, Portugal, Spain, Brazil.
Main use: High-speed cutting tools.
Current supply: More than adequate.

Zinc (35%)

Source: Canada, Mexico, Peru, Bolivia, Spain.
Main use: Galvanizing; pigments; brass.
Current supply: Adequate.

Clad Metals Grow

Use of clad metals is growing rapidly, says the American Iron and Steel Institute. For example, the use of steel plates permanently clad with



USED FOR COPPER BRAZING of hardware parts, this electric furnace was built by American Electric Furnace Inc., Boston, Mass. for Sargent & Company, well known hardware manufacturers of New Haven, Conn. The alloy conveyor belt at right runs over Norton CRYSTOLON* hearth tile in the furnace.

More proof that Norton Special Refractories cut furnace operating costs

Here's a typical case of how Norton CRYSTOLON hearth tile pays off in low-cost, trouble-free service and greater overall furnace efficiency. And not just in one or two advantages, but in every detail essential to top performance. For example:

- This Norton CRYSTOLON hearth provides an ideal refractory bed for the conveyor belt. It exerts so little abrasive action on the belt, and its resistance to the belt's abrasive action is so high, that neither tile nor belt have required any replacement in almost three years of steady operation.
- Equally important: the great strength, high thermal conductivity and uniform heat dispersion of CRYSTOLON refractories are valuable aids to better, more economical furnace performance.
- As proved in many similar high heat applications, CRYSTOLON refractories —due to the Norton method of processing silicon carbide — *will not warp.*

Let Norton Help You

Since no single refractory combines every desired property in the highest degree, no one refractory meets every need for every user. However, Norton CRYSTOLON silicon carbide, ALUNDUM* fused alumina, MAGNORITE* fused magnesia and the sensational new FUSED STABILIZED ZIRCONIA provide a complete line of refractory compositions, shapes and cements, covering the range of applications.

Most likely this broad, varied line already covers your own requirements. If not, your Norton Refractories Engineer, backed by over 40 years of Norton pioneering and development will gladly help you to get money-saving results—with refractories engineered to your exact needs. Call him for this valuable service. Or write to NORTON COMPANY, 344 New Bond Street, Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

NORTON

Special REFRACTORIES

Making better products to make other products better

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

NO. 2 IN A SERIES

UNITCASTINGS are consistently better!

"Palletizing"

SAVES YOU HANDLING TIME!

For greater efficiency, your steel castings are handled *on pallets* in the Unitcast foundry . . . and, if you desire, can be *shipped* to you on pallets to save handling time and expense at your end.

Your fork-lift trucks can move "Palletized" casting shipments directly to your assembly floor or machining operation *in quantity and without additional and unnecessary handling!*

Cut your handling costs . . . *specify Palletizing!* Another time-saving service available from Unitcast.

UNITCAST Corporation
QUALITY STEEL CASTINGS

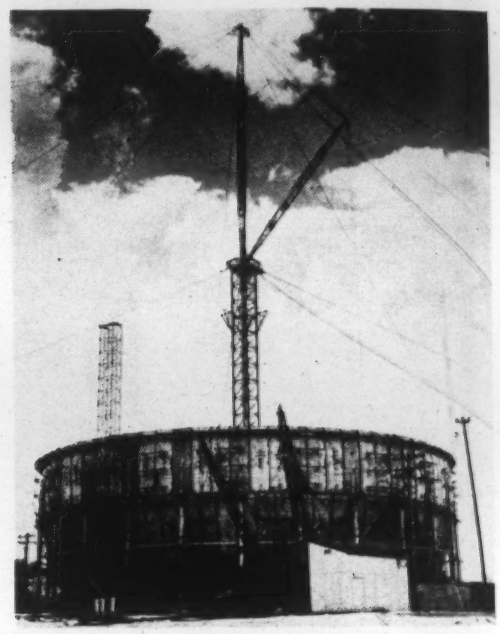
Our steel casting specialists welcome the opportunity of working with you on your parts problems... their suggestions at the design stage can pay you continuous dividends.

Write or call . . . Unitcast Corporation, Steel Casting Division, Toledo 9, Ohio; 701 New Center Bldg., Detroit, Michigan; In Canada: Canadian-Unitcast Steel, Ltd., Sherbrooke, Quebec.

UNITCASTINGS are FOUNDRY ENGINEERED

News Digest

copper, stainless steel, nickel or other metals has increased more than 20-fold since 1939, according to one steel executive. Meanwhile, the makers of clad steels are said to have their eyes on new clad metals, incorporating such materials as tantalum, titanium and zironium.



Atomic Power House When complete, this structure at West Milton, N. Y., will be a gigantic sphere and will house an atomic power plant for submarines. The plant is being built by scientists of Knolls Atomic Power Laboratory, which is being operated by General Electric Co. for the AEC.

I.M.C. Allocates Only Nickel, Moly

Only for nickel and molybdenum is there a serious gap between supply and demand, according to a recent report by the International Materials Conference.

The I.M.C. was organized two years ago to work out voluntary allocations of scare materials among 27 free world nations. Nickel and molybdenum are the only materials now remaining under its allocation.

The free world's nickel supply increased by almost 11% in the year ended Feb. 28, 1953, and the molybdenum supply jumped by almost

Partial Assemblies Courtesy of Hermetic Seal Products Co.

Now 4 D-H Special Alloys Cover Most Glass-to-Metal Sealing Needs

From a single source, the Driver-Harris Company, you can now obtain metal alloys to meet your glass-to-metal sealing needs for both *hard* and *soft* glass.

NEW ALLOY THERLO* This cobalt, nickel iron alloy, possesses ideal properties for sealing hard or thermal shock resistant glass. It matches such commercial hard glasses as Corning 7052 and 7040 in expansivity from 80°C to the annealing point. It produces a permanent vacuum-tight seal with simple oxidation procedure and resists attack by mercury. Readily machined and fabricated, it can be welded, soldered or brazed.

DRIVER-HARRIS 142 ALLOY contains 42% nickel. This is the standard alloy for sealing into sealed beam auto lamps using Corning 776 glass. Used with a borated copper coating, it is the accepted seal for incandescent lamps and radio tubes and matches 8160 glass.

DRIVER-HARRIS 52 ALLOY contains 50% nickel. It provides a slightly higher coefficient of expansion than the D-H 142 alloy and seals successfully with 0120 glass.

DRIVER-HARRIS 146 ALLOY contains 46% nickel. It offers special expansion properties, which permit seals with ceramic coated materials as shown above.

Manufactured to the same high standards that have made Driver-Harris the leader in special purpose alloys for more than 40 years, these alloys are available as rod, wire, strip, sheet foil—and in special shapes. They enable you to meet your specific sealing needs from a single source — so why not consult us today.

*T.M. Reg. U. S. Pat. Off.

Also sole producers of Nichrome, Advance* and Karma**

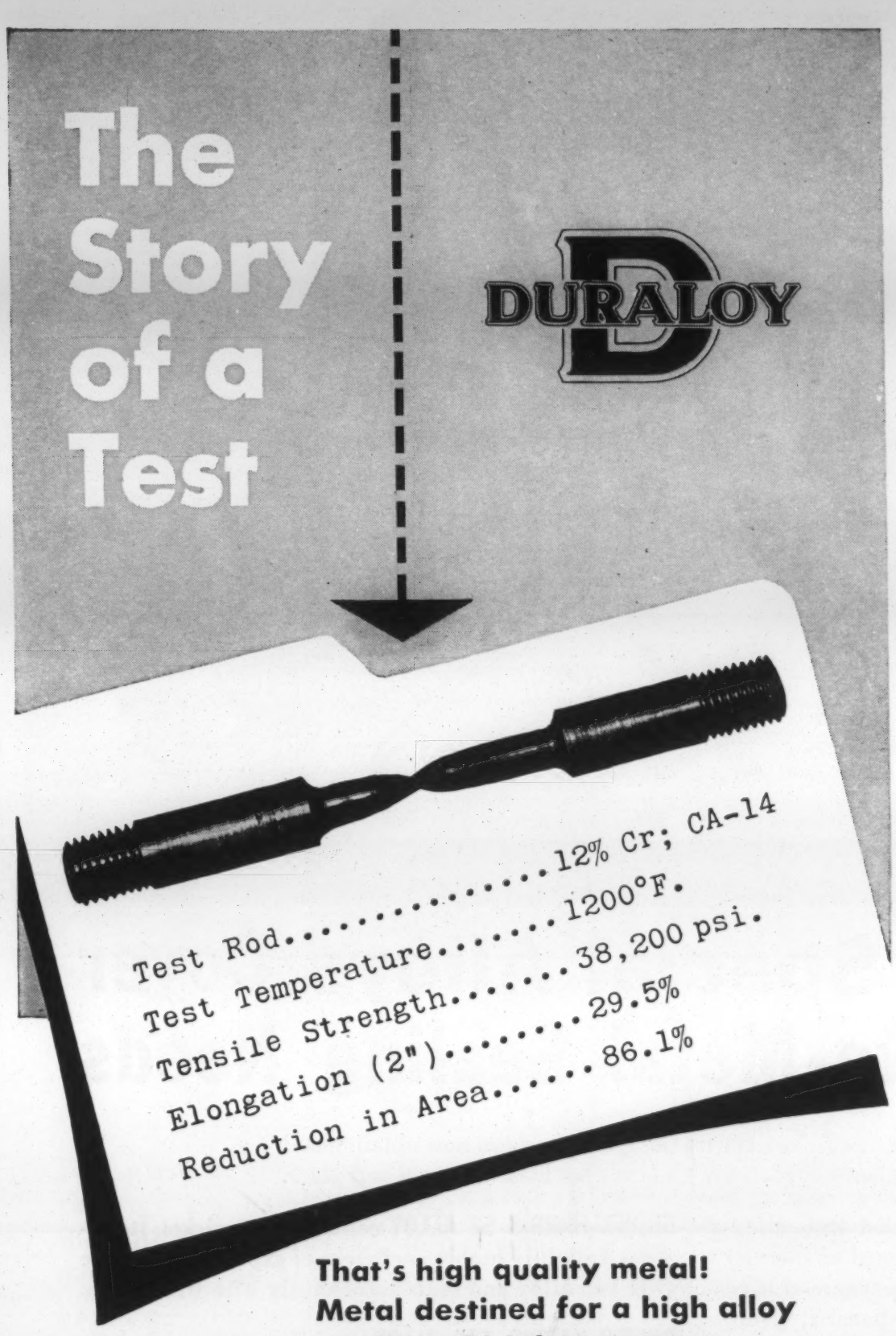
Driver-Harris Company

HARRISON, NEW JERSEY

BRANCHES: Chicago, Detroit, Cleveland, Los Angeles, San Francisco

In Canada: The B. GREENING WIRE COMPANY, Ltd., Hamilton, Ontario.

MAKERS OF THE MOST COMPLETE LINE OF ELECTRIC HEATING, RESISTANCE, AND ELECTRONIC ALLOYS IN THE WORLD



That's high quality metal! Metal destined for a high alloy casting which has to meet some pretty rigid specifications!

The story we want to tell here is about our Testing Facilities. We have right in our foundry every conceivable testing facility needed when checking static or centrifugal high alloy castings for industry. Where required, we make complete chemical, metallurgical, and mechanical checks and tests. And have both a 400,000 volt X-ray unit and gamma-ray unit, for checking the final casting for hidden flaws.

As we see it, the only way to assure customers of high quality castings is to have and use all necessary facilities for testing and checking the heat, pour and finished casting.

THE DURALOY COMPANY

Office and Plant: Scottdale, Pa. • *Eastern Office:* 12 East 41st Street, New York 17, N.Y.

Atlanta: J. M. TULL Metal & Supply Co.
Detroit: W. D. HAZLETON 805 New Center Building
Chicago: F. O. NELSON 332 S. Michigan Avenue
METAL GOODS CORP: Dallas • Denver • Houston • Kansas City • New Orleans • St. Louis • Tulsa

News Digest

24%. Allocations are still needed, however, the I.M.C. said.

The report presented a generally optimistic picture. Allocations had been removed on five materials—copper, zinc, cobalt, tungsten and sulfur—during the past year. General supply improvements were attributed to increased production, conservation and substitution, levelling off of demand for defense production, and more orderly market conditions.

According to I.M.C., free world production of materials has generall increased since 1950. Some estimated percentage increases as of the beginning of 1953 were: copper, 10; zinc, 24; nickel, 26; cobalt, 58; tungsten, 130; and molybdenum, 75%.

Boron Steels

Production of boron-containing alloy steel ingots in 1952 was over 700,000 net tons, nearly double the 355,000 tons in 1951.

Figures released by the American Iron and Steel Institute show that output of boron steel was about 8.8% of the total output of alloy steel ingots other than stainless, compared with 3.9% in 1951. Little boron was used in steel before the Korean war.

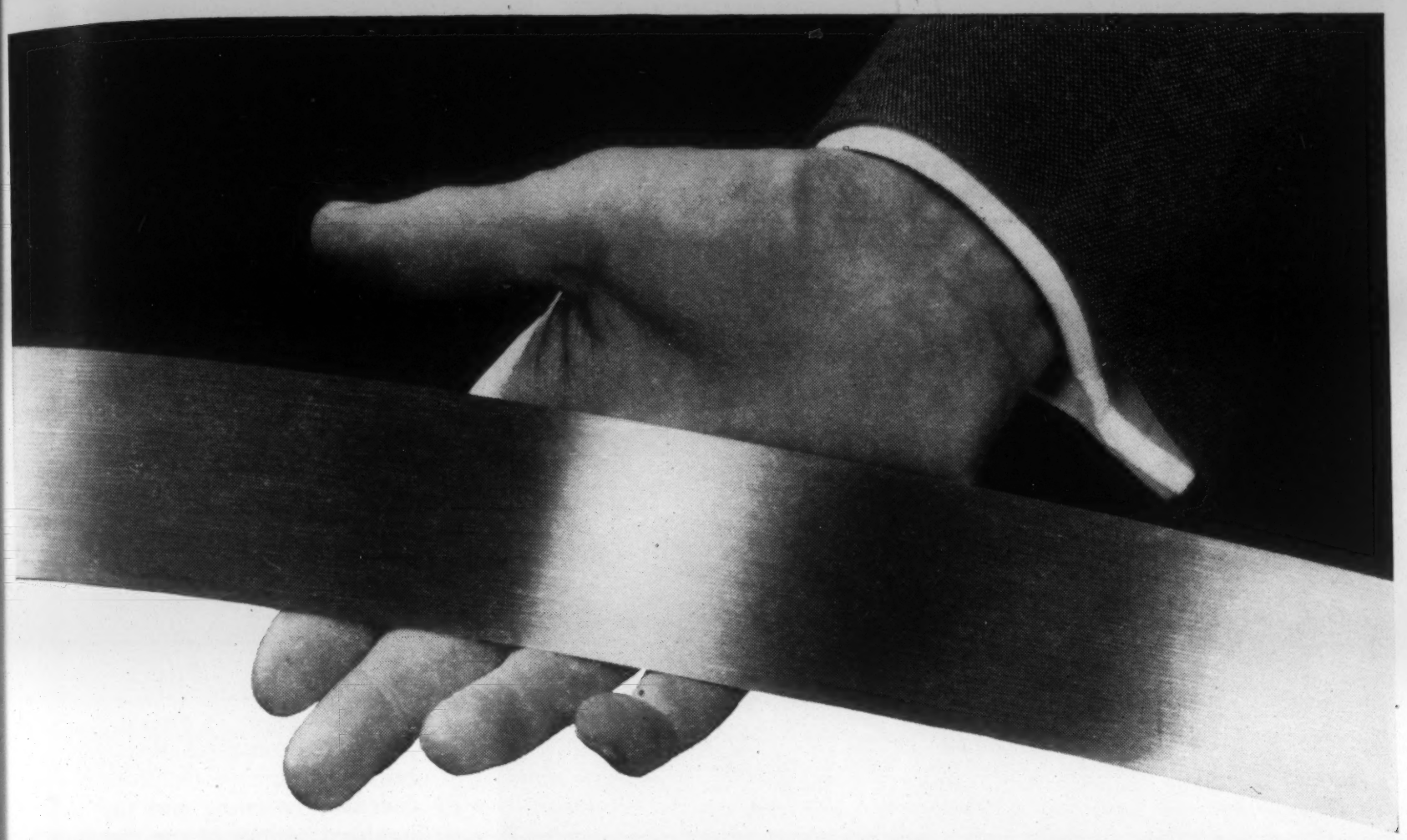
NBS Scientists Speak on Fracture

Metallurgists of the National Bureau of Standards recently got together to talk about deformation and fracture of metals. Listening were almost a hundred representatives of industry and the government, as well as many of the Bureau staff.

The occasion was the annual NBS Metallurgy Conference, held this year, under the joint chairmanship of J. A. Bennett and L. L. Wyman, respective heads of the Mechanical Metallurgy and Chemical Metallurgy Sections. After a welcoming address by the Director, Dr. A. V. Astin, five papers describing recent progress at the Bureau were given.

Stress Corrosion

Stress-corrosion cracks in brass originate as pits, according to H. L.



How temperamental can a piece of steel be?

● Plenty! Because steel is one of the most *versatile* of all materials, it can play tricks on you . . . can be mighty temperamental, even obstinate. But, properly controlled, it works for you precisely the way you want it to!

For generations, National-Standard's Athenia Steel Division has specialized in the behavior engineering of high carbon steel for the most exacting services. Here, they've learned how to take the fullest *advantage* of steel's versatility. It results in specially engineered, rigidly controlled steels that do a *better* job in all kinds of products from umbrella ribs and pen points to camera springs and piston rings.

Perhaps defense production brings you new problems in the application or behavior of steel. National-Standard and Athenia offer you the kind of engineering and development service that has speeded production and cut costs for many and many a manufacturer.

NS NATIONAL-STANDARD Company NILES, MICHIGAN

DIVISIONS OF NATIONAL-STANDARD CO.

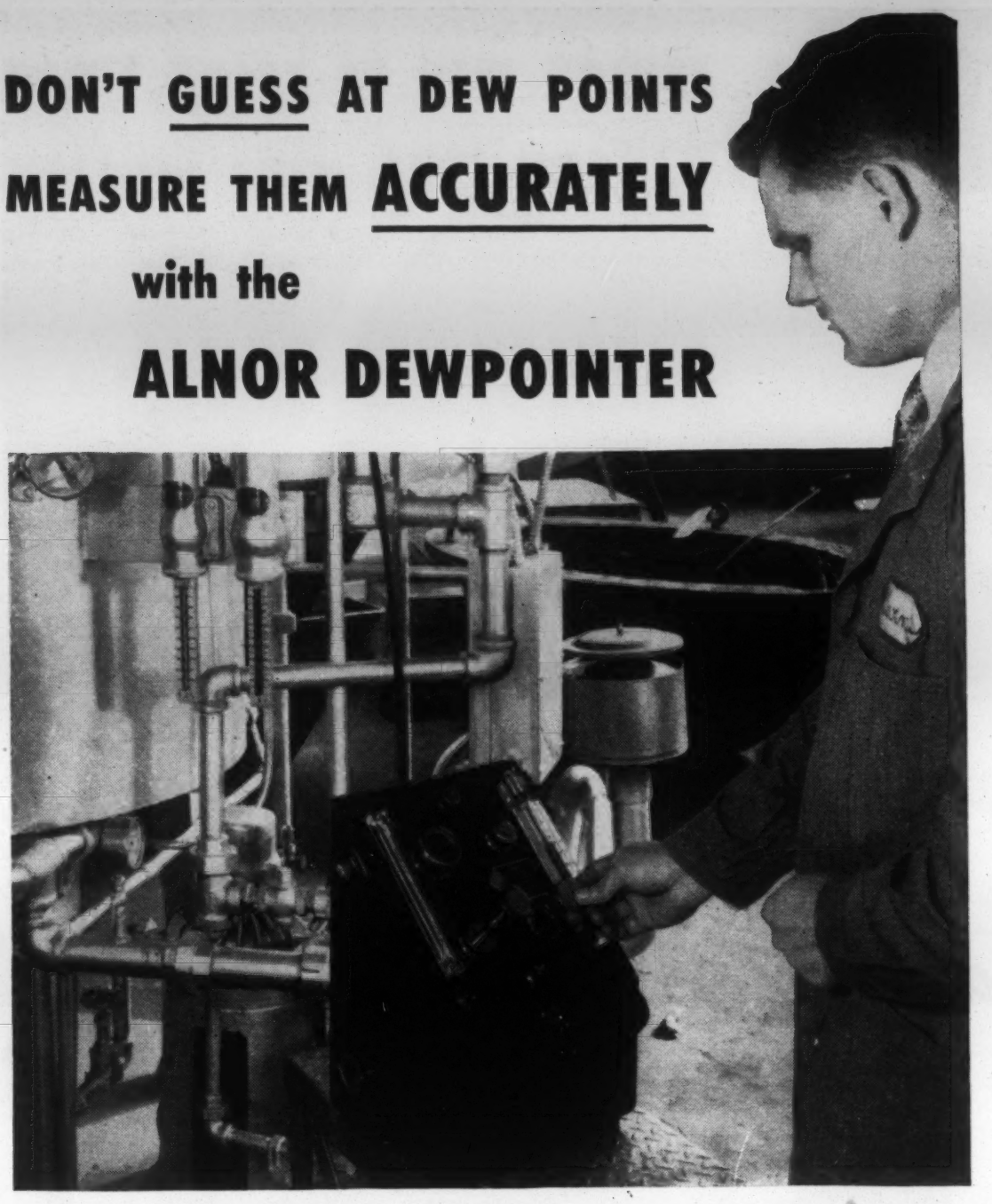
ATHENIA STEEL	*Clifton, N. J.*	Flat, High Carbon, Cold Rolled Spring Steel
NATIONAL-STANDARD	*Niles, Mich.*	Tire Wire, Stainless, Fabricated Braids and Tape
REYNOLDS WIRE	*Dixon, Illinois*	Industrial Wire Cloth
WAGNER LITHO MACHINERY	*Jersey City, N. J.*	Metal Decorating Equipment
WORCESTER WIRE WORKS	*Worcester, Mass.*	Round and Shaped Steel Wire, Small Sizes

DON'T GUESS AT DEW POINTS

MEASURE THEM ACCURATELY

with the

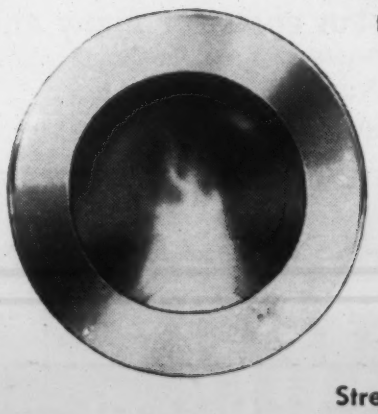
ALNOR DEWPOINTER



Here's the modern way to quickly and *accurately* read the dew point in controlled atmospheres—the Alnor Dewpointer. Its simple, direct operation assures laboratory accuracy by non-technical personnel . . . in the field, plant, or wherever precision checking is necessary for quality results.

The Dewpointer is the only instrument of its kind that is self contained . . . it is readily portable and requires no external coolant or auxiliary apparatus. Operates on either A.C. or enclosed battery power. Over 600 large industrial concerns rely on Dewpointer precision and many find the instrument pays for itself in savings on CO_2 alone.

Guesswork Eliminated



The Dewpointer eliminates all guesswork—as when trying to read indications on a polished surface in other less accurate instruments. You actually see the dew or fog suspended in the enclosed chamber—under conditions that can be controlled and reproduced accurately. You'll want to know more about this unique instrument that brings portable laboratory precision to your dew point determinations, so send today for your copy of the Dewpointer Bulletin. Illinois Testing Laboratories, Inc., Rm. 522 420 N. La Salle Street, Chicago 10, Ill.

Alnor PRECISION INSTRUMENTS FOR EVERY INDUSTRY

News Digest

Logan. These pits become regions of stress concentration with resulting rupture of the protective film, and a concentration cell is set up between these areas and the adjacent filmed alloy. In beta-brass, film rupture often occurs along traces of planes normal to the direction of low yield strength. In alpha-brass, film rupture occurs at the bottom of pits.

G. W. Geil used the initiation and propagation of deformation twins as a tool to study the formation of brittle fractures in notched ingot iron at low temperatures. Tension tests were run on circumferentially notched cylindrical specimens at —320 F. The fractured surfaces of these specimens had the appearance characteristic of brittle failures. However, metallographic examination showed that the brittle fracture of the iron was preceded by twinning and slip in very localized regions of the specimen indicating that the iron retained some ductility. Similar results were obtained on Charpy impact tests made at the same temperature.

J. G. Weinberg reported on the fatigue notch sensitivity of three high strength aluminum alloys (24S-T4, 61S-T6, and 75S-T6). The determinations were based on the number of cycles at which the first fatigue crack formed. In many cases the notch sensitivity values were close to unity but the results for 75S-T6 showed relatively low notch sensitivity for this alloy and it was suggested that this might be associated with inhomogeneity of the material. The proportion of the total life of the specimens between formation of the first fatigue crack and final fracture increased with increasing stress amplitude and with increasing notch severity.

Plastic Flow

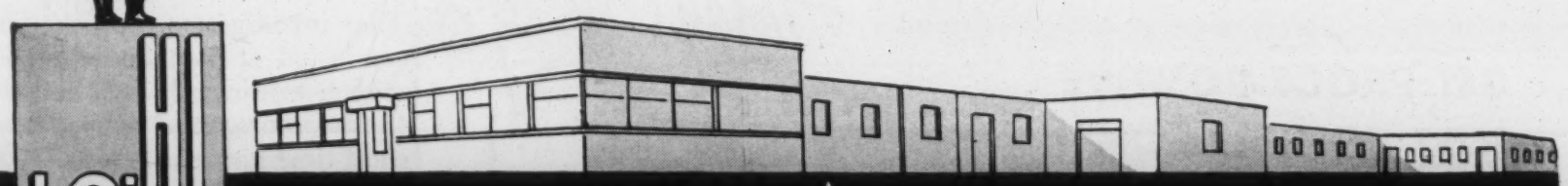
Discussing the mechanism of plastic flow at elevated temperatures (70 to 1700 F) of a high-purity and a commercial 70 Ni—30% Cu alloy and of high purity nickel, William D. Jenkins observed that substructures formed as a result of annealing increased in size with increase in annealing temperature and in grain size. This factor was considered responsible in part, for the lower tensile strength, yield strength, hardness and creep strength of alloys when tested at elevated temperatures. Examination of fractured specimens showed the effects of temperature on crystal recovery and grain boundary

Anyone in the metal finishing business knows "grime doesn't pay"—and anyone who has been around long can tell you that with Northwest's methods and materials even the toughest jobs "come clean" in a jiffy.

Northwest's top quality products used in a carefully "job-adjusted" manner worked out for you by our thoroughly experienced "cleaning specialists" is your assurance of a finish you can depend on.

Got a problem? Let our cleaning experts help you!

Cleaning is the key to fine finishing—be SURE of the result with Northwest's products and personalized service.



NORTHWEST CHEMICAL CO.

9310 ROSELAWN DETROIT 4, MICH.

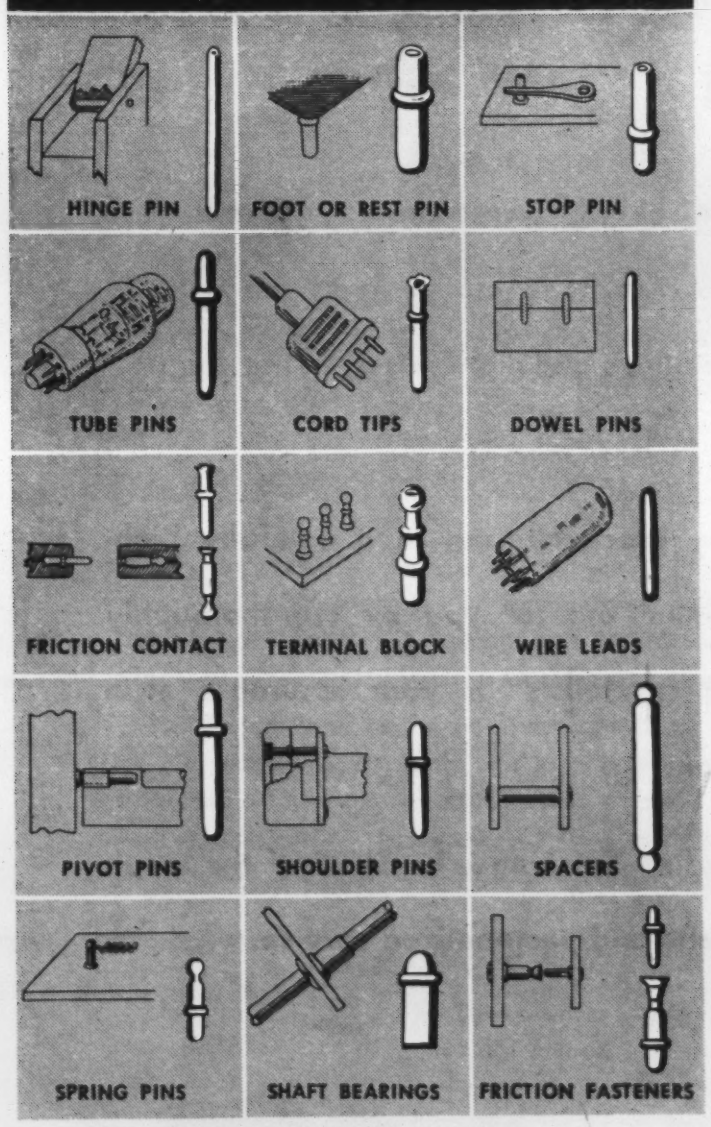
pioneers in pH cleaning control *serving you since '32*

SMALL PARTS can play a BIG PART in...

Lower Production Costs!

Leading manufacturers in the electronics, machinery, appliance and toy fields have been saving substantially by using precision Multi-Swage parts instead of those previously made by turning, drilling, stamping or forming.

HERE ARE ONLY A FEW TYPICAL TINY PARTS MADE BY BEAD CHAIN'S
Economical, Dependable
MULTI-SWAGE METHOD



LET BEAD CHAIN MAKE YOUR

Tiny Parts to your Specifications at far less cost!

The advanced manufacturing method developed and used exclusively by Bead Chain swages practically any type of small tubular part from flat stock into precision forms with positive, tight seams . . . and does it *Automatically*. If you can use high-volume production . . . we can deliver it at a much faster rate . . . and at far less cost! Scrap is eliminated! Deliveries to you are dependably prompt!

We can supply you with parts that are beaded, grooved, shouldered and made with almost any metal. Diameters up to 1/4", lengths to 1 1/2"

This catalog can save you a lot of production time and money! Write for it

today!

GET PROOF-POSITIVE COST COMPARISONS!

Send us a blueprint or sample and quantity requirements. We will quickly show you the big economies we can deliver.

BEAD CHAIN®

Original and World's Largest Producer of Bead Chain

THE BEAD CHAIN MFG. CO.
BRIDGEPORT 5, CONNECTICUT

Please send me your Catalog of Multi-Swage Parts

NAME .....

TITLE .....

COMPANY .....

ADDRESS .....

KEY NO. 15

THE BEAD CHAIN MANUFACTURING CO., BRIDGEPORT 5, CONN.

News Digest

weakening followed by intercrystalline failure.

H. C. Burnett reported that the reversed bending fatigue properties of music wire indicate the approximate fatigue strength of helical compression springs wound from the wire. Initial fatigue cracks in the springs occurred on the longitudinal planes of maximum shear stress in the wires and the cracks frequently progressed through more than half the diameter before fracture occurred. Surface defects on the wires are contributing factors in increasing the scatter of fatigue data obtained on testing the springs.

What's Ahead in Alloy Castings

Users of alloy castings can get a good idea of what the future may hold in the way of new and improved materials from a recent report by the Alloy Casting Institute. From this report emerges a broad pattern of applied and fundamental research already scheduled for the next five years.

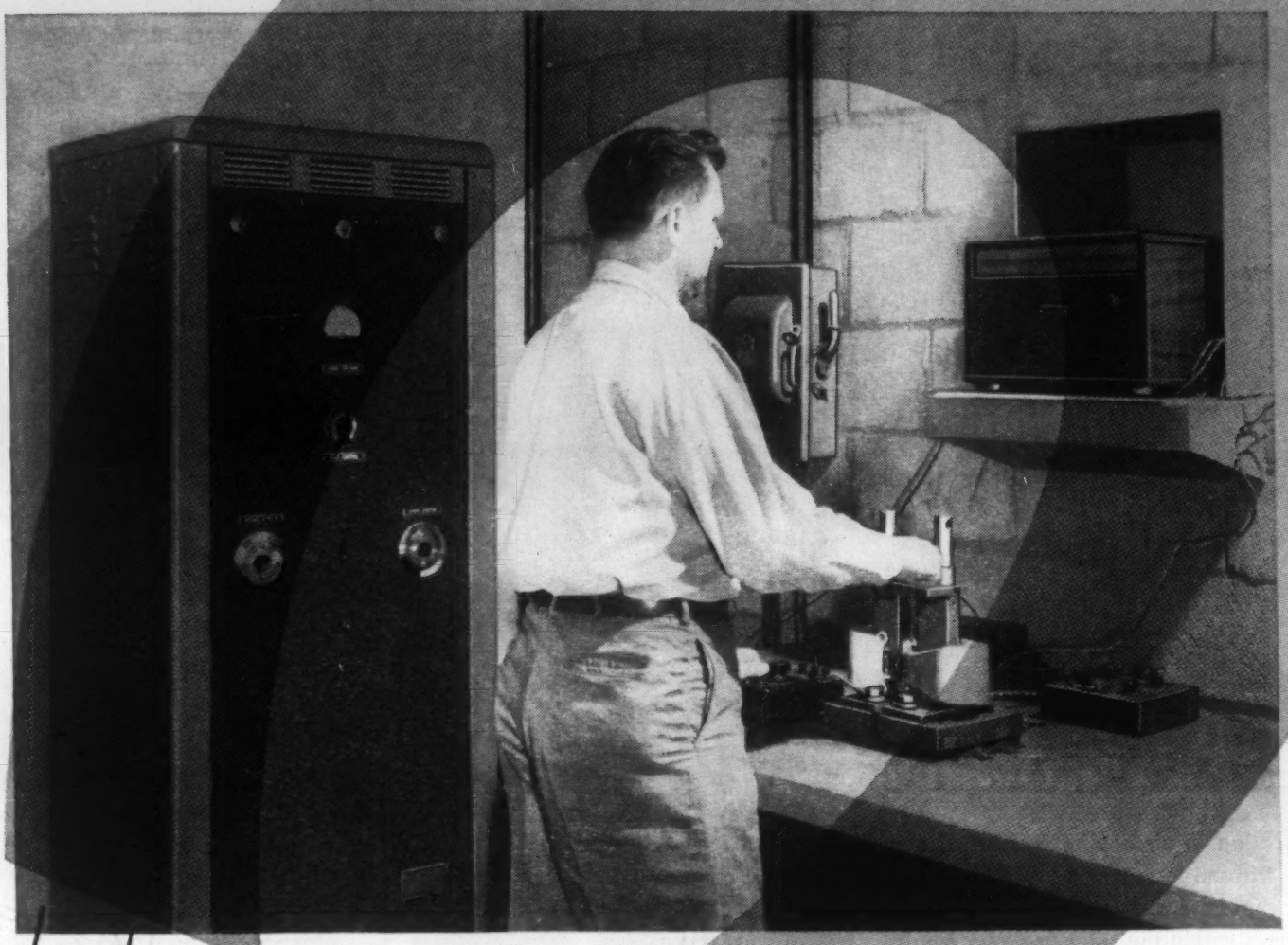
Some of the major programs are described briefly below:

1. Use of low carbon wrought stainless steels of chemical compositions similar to the cast corrosion resistant grades in service at temperatures in the 1000 to 1600 F range has resulted in a demand for castings in such applications. To provide mechanical property design data, the 12% Cr (CA-15), 18 CR-8 Ni (CF-8, CF-8C, CF-8M), 25 Cr-12 Ni (CH-20) and 25 Cr-20 Ni (CK-20) grades will be studied at temperatures of 1000, 1300 and 1600 F. The investigation, which will be conducted at Battelle Memorial Institute, will include 100- and 1000-hr stress-rupture tests, creep tests and short-time hot tensile tests.

High Temperatures

2. Another important project in the Battelle program is the development of alloys suitable for service above the range 2000 to 2100 F. The objective is either to provide mechanical and corrosion resistance properties better than obtainable with

...Another Crucible Service for Magnet Users



160,000

ampere turn,

impulse magnetizer

now available

Magnet users are reducing manufacturing costs and improving their products through the use of this new, capacitor discharge-type, impulse magnetizer — another example of Crucible's leadership in serving industry.

This Crucible development has an improved firing circuit . . . is more compact . . . requires less maintenance . . . and results in more efficient magnetization.

For further information on the availability and operation of the Crucible Impulse Magnetizer, write to Crucible Steel Company of America, General Sales Offices, Oliver Building, Pittsburgh, Pa.

CRUCIBLE first name in special purpose steels

53 years of Fine steelmaking

ALNICO PERMANENT MAGNETS

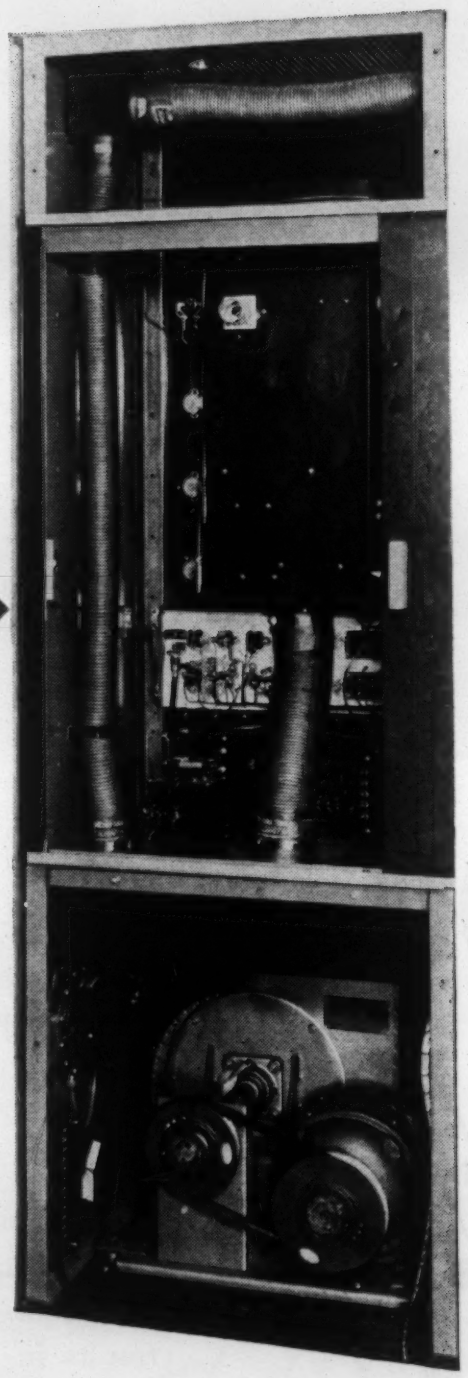
CRUCIBLE STEEL COMPANY OF AMERICA, GENERAL SALES OFFICES, OLIVER BUILDING, PITTSBURGH, PA.

STAINLESS • REX HIGH SPEED • TOOL • ALLOY • MACHINERY • SPECIAL PURPOSE STEELS

WHEN DESIGN CALLS FOR DUCTING—
engineers should know about
FLEXIBLE'S LINE OF TUBING

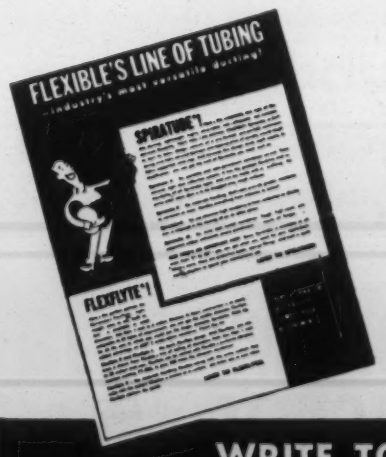
Every advantage you want:

- **Bends at any point**
- **No exposed wire to rust or obstruct air passage**
- **Long life**
- **Quick to connect or disconnect**
- **Extra strong yet lightweight**
- **Abrasion resistant**
- **Withstand high temperatures or pressures**



Flexflyte application in air cooling system of new RCA television transmitter. A primary reason why Flexflyte was chosen for this job: "Turbulences and friction losses within the tube are very small" *compared to others that were tested.*

You're missing a good bet, if you haven't discovered the many advantages of Flexible's complete line of tubing for all ducting systems. This new-type flexible ducting is available in sizes from less than 1 inch to 30" with special fabrics and coatings engineered to special needs. Our staff of field engineers is ready to help you with your flexible ducting application.



Flexible Tubing
CORPORATION
Guilford, Connecticut Pasadena 1, California

WRITE TODAY FOR FULL DETAILS ON FLEXIBLE'S AMAZING COST-SAVING DUCTING!

News Digest

present alloys, or to get equal properties with alloys of lower strategic element content.

3. A study authorized at Battelle will determine the high temperature strength properties of alloys, not too widely used at present, that may be useful to design engineers as possible alternates for higher nickel alloys. These grades have regular ACI specification designations—HC (28 Cr), HD (28 Cr, 5 Ni), HE (29 Cr, 10 Ni), HI (28 Cr, 15 Ni), HL (30 Cr, 20 Ni) and HN (20 Cr, 25 Ni)—but they are not used as extensively as some of the better known alloys because their heat resistance properties have never been completely studied. The proposed investigation will last about five years, and should enable these grades to take their places among the more widely used types.

4. Another study authorized at Battelle is the comparative resistance of three heat resistant grades—HH (25 Cr, 12 Ni), HK (25 Cr, 20 Ni), and HT (15 Cr, 35 Ni)—to 1000-hr exposure to carburizing atmospheres at 1700 to 1800 F. The HT grade is normally used in carburizing service, but previous research and some field experience indicate the possibility of using the HH and HK types as well.

Contaminants

5. An important contribution to alloy conservation will be the study of the effect of "tramp" elements on corrosion resistance, heat resistance and foundry characteristics of cast high alloys such as CF-8 and CF-8M. With limited amounts of primary metals available, it is necessary for alloy producers to utilize the maximum amount of purchased scrap. Unfortunately, the general scrap problem is now acute; not only is there a shortage, but scrap is improperly segregated and unknown elements are thus introduced. These "contaminants" include copper, tungsten, lead, tin, antimony, zinc, aluminum, arsenic, cadmium and others. This investigaton will attempt to determine the maximum amount of such elements that can be tolerated in castings intended for specific applications.

6. There has been an insistent demand for cast alloys having the corrosion resistance of the 18:8 types, but with much higher strength than

(*Advertisement*)

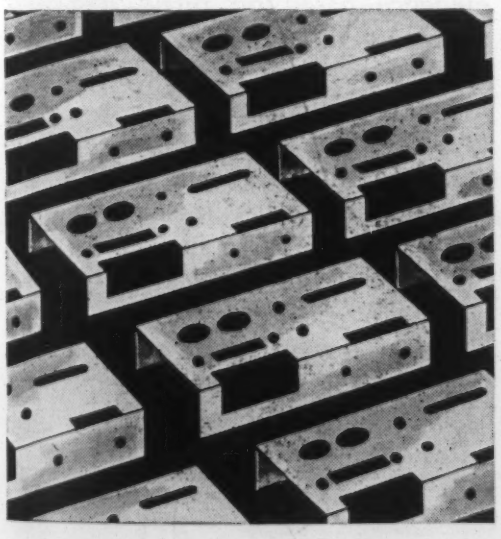
Fingerprints and Water Stains On Copper Plate Prevented by Water Dip Treatment

The common problem of fingerprinting, water staining and oxidation on copper-plated surfaces has been effectively solved by the use of Water Dip #33 for applying a protective coating to the copper plate.

This treatment is extremely economical, since the work goes directly from the hot water rinse into the Water Dip tank, without any need for intermediate drying and rehandling.

Speeds up soldering

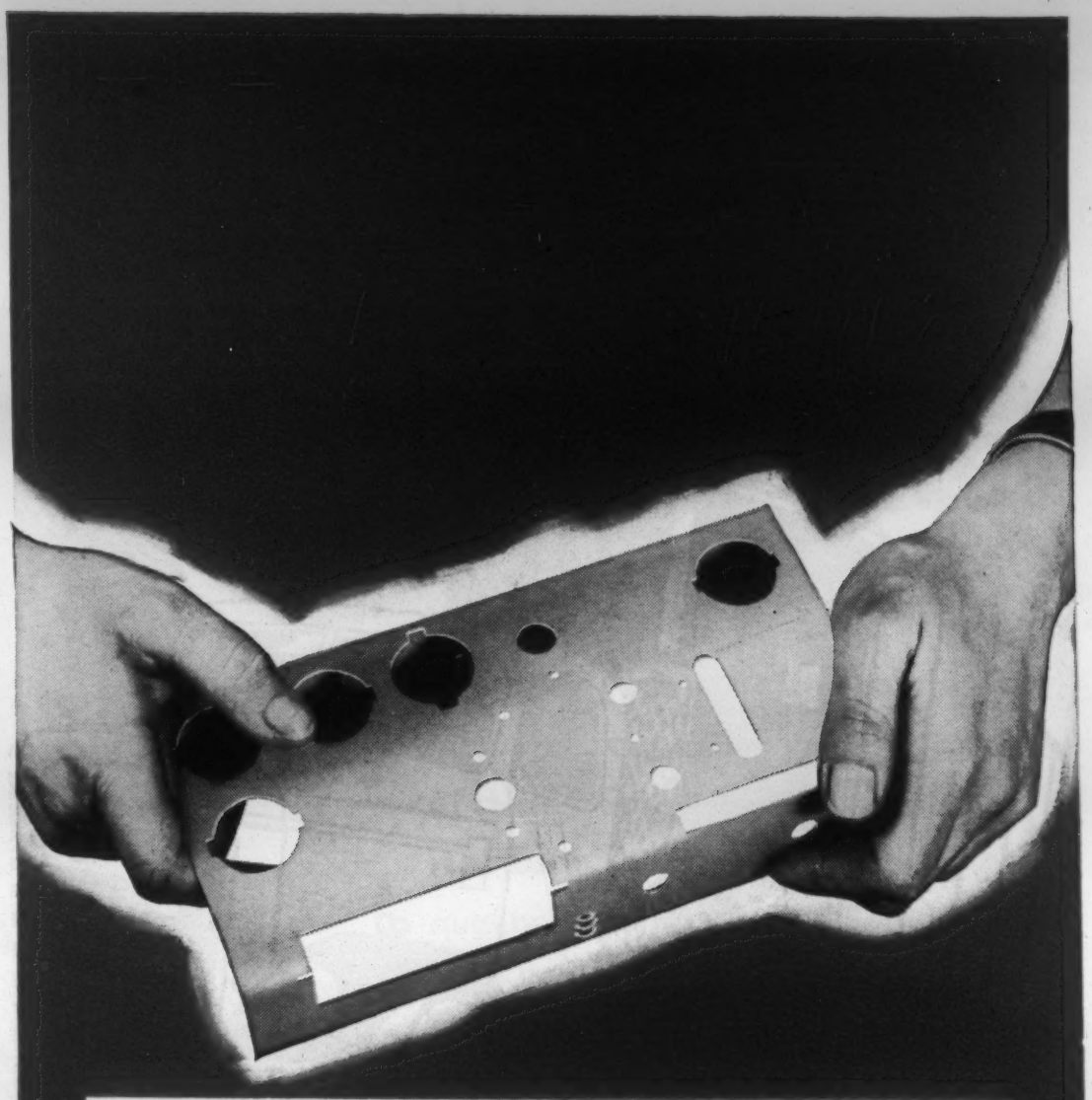
Application of Water Dip #33 not only does not interfere with subsequent soldering, as in the wiring of radio chassis, but actually improves and speeds up the operation. The coating prevents the usual formation of metal oxides while parts are in storage prior to wiring, and in most cases the electrical resistance of Water Dip #33 is no higher than the oxides would offer.



5000 radio chassis were copper-plated by one manufacturer and dipped in Water Dip #33. There were no rejects after riveting and soldering operations.

Less risk of error

While Water Dip #33 is colorless as supplied, dyes can readily be added for identification of terminals or other parts. This gives quick visual identification that simplifies the job of connecting wires to the right terminal, and saves inspection time. Water Dip #33 is produced by Maas & Waldstein Company, Newark 4, N. J., and is described in Technical Data Bulletin #117, available from the manufacturer.



Copper-plated Parts Stay Bright and Clean

when the plating shop treats them with WATER DIP #33

● If you are doing your own copper plating or buying copper-plated parts . . .

Then you'll want the full story on a simple, low-cost metal treatment that *keeps* the copper surface bright and chemically clean—just as it comes from the plating bath. *M & W Water Dip # 33 prevents finger printing and staining during assembly, storage and use.*

If you're doing copper plating, you can cut out extra operations by using Water Dip #33. Work goes *directly* from the last hot water rinse into Water Dip #33—no need for rehandling and drying!

If you're using copper-plated parts, you'll find that you can make excellent soldered connections—or strong, uniform welds even after the parts have been dipped in Water Dip #33.

Water Dip #33 has many more advantages—in many types of plating. For the complete story, write for Technical Data Bulletin #117, or let our M & W technical consultant discuss your requirements privately with you.

PIONEERS IN PROTECTION

OUR 78th YEAR • M & W CO. 1874

MAAS & WALDSTEIN CO. [illegible] NEWARK 4, NEW JERSEY

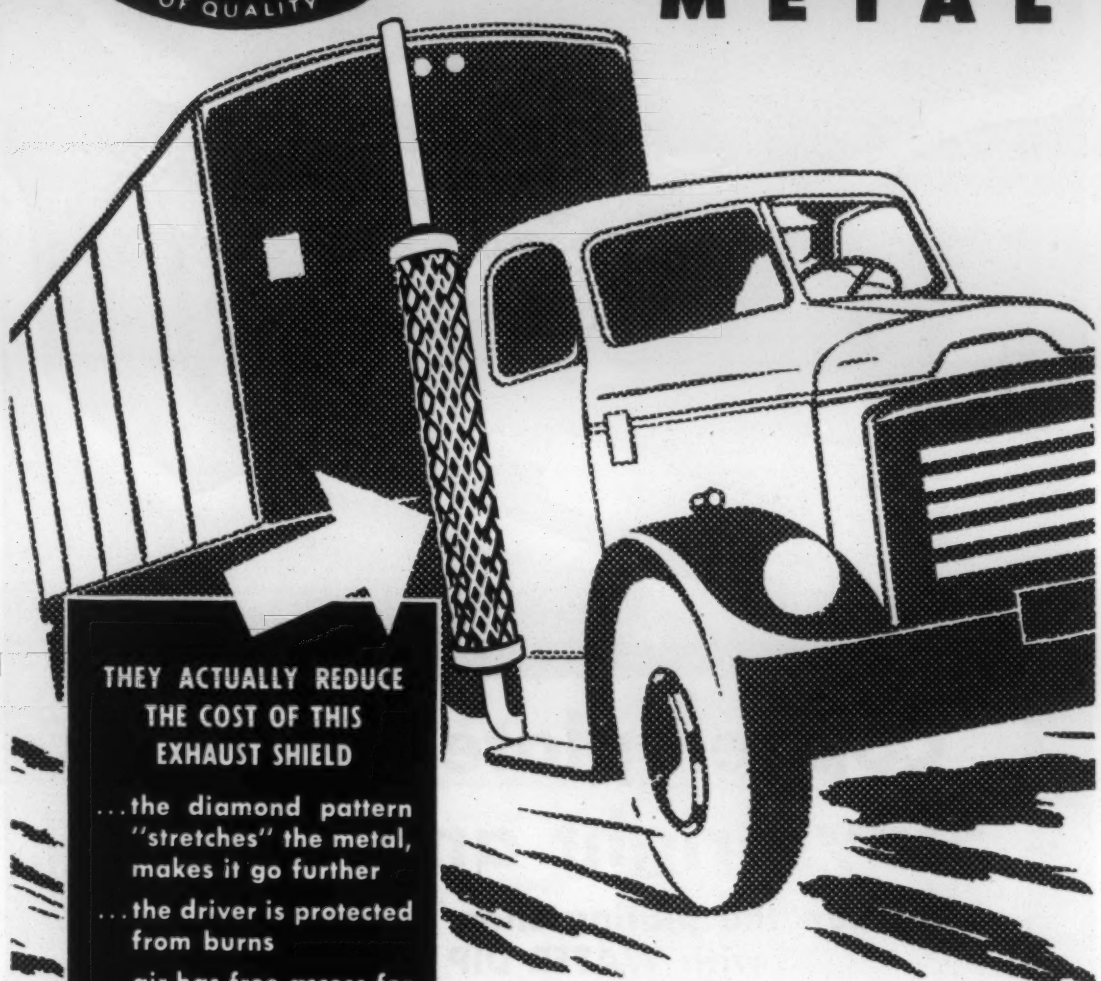
[illegible]

MANUFACTURERS OF INDUSTRIAL FINISHES

Cheapest "Diamonds" You Can Buy

METAL MARK Penmetal 1869 OF QUALITY

EXPANDED METAL



THEY ACTUALLY REDUCE THE COST OF THIS EXHAUST SHIELD

...the diamond pattern "stretches" the metal, makes it go further

...the driver is protected from burns

...air has free access for cooling

and you have an attractive product!

Manufactured of ½" 18 gauge PENMETAL by Toledo Pressed Steel Company for GMC Truck & Coach Company

EXPANDED METAL MESH

OPEN TO LIGHT, HEAT AND AIR. PENMETAL expanded metal is the material of economy—for protecting, for screening, for lightweight yet strong construction.

MAKES A LITTLE METAL GO A LONG WAY. PENMETAL expanded metal is sheet metal which has been slit, then stretched to as much as 10 times original area.

CORROSION-RESISTANT METALS AVAILABLE, as well as carbon steel. Large or small mesh, light or heavy gauge. Each sheet is a unit without rivets or welds.

UP TO 80% LIGHTER than solid sheet of same dimensions. Diamond truss pattern adds rigidity and strength.

METAL MARK Penmetal 1869 OF QUALITY

For more information. write for Free Bulletin EM43

PENN METAL COMPANY, INC.

GENERAL SALES OFFICES • 205 East 42nd Street, New York 17, N. Y.

BOSTON PHILADELPHIA WASHINGTON PARKERSBURG, W. VA.
DETROIT CHICAGO DALLAS LOS ANGELES SAN FRANCISCO SEATTLE

News Digest

now available in these grades. This need has been recognized by a project with two main objectives: (1) a cast material having minimum yield strength of 100,000 psi and 10% minimum elongation; (2) a hardenable cast material with a minimum hardness of 350 Brinell and a minimum elongation of 5%. This alloy would be particularly useful for anti-galling or anti-seizing applications.

Fundamental Studies

7. It is impossible to transfer results obtained in a specific corrosion test with a specific alloyed material to another set of conditions or materials. The reasons why various corrodents act differently with different alloys—producing generalized corrosion with some, intergranular corrosion with others, and pitting or localized corrosion in others—are the goal of a fundamental, long-range study of corrosion authorized at Ohio State University under Dr. M. G. Fontana.

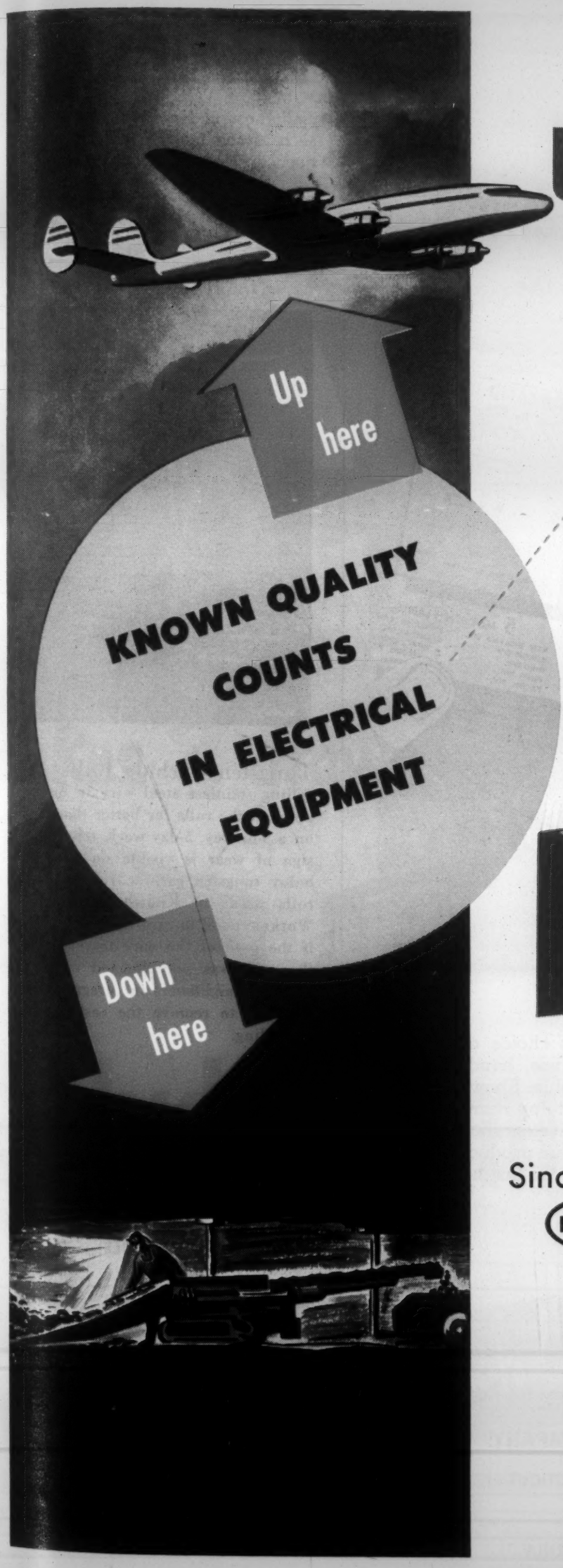
8. A second basic research program to be started is the study of the relationship, if any, between the magnetic and corrosion resistance properties of the CF-8 grade. Preliminary evidence based on nitric acid tests shows no difference in corrosion resistance between the magnetic and nonmagnetic varieties of the CF-8 grade. However, the study will attempt to show whether there is any difference in other media. The investigation will also include a determination of the chemical ranges necessary to ensure wholly austenitic alloys of low magnetic permeability, since the CF-8 alloys are sometimes used where the nonmagnetic properties are essential.

Soft Magnetic

A new "soft" magnetic material composed of noncritical metals has been developed by the Naval Ordnance Laboratory.

Named 16-Alfenol, the new material is composed of 16% aluminum and 84% iron. The alloy itself is not new and was used by the Japanese during World War II with some success.

With properties superior to silicon iron, it is expected to be espe-



Use this assurance!

In the critical applications where life may depend upon a single thread of copper, the *known quality* of Hussey Copper has earned its reputation. Hussey's controlled quality manufacturing methods have established unusually high standards of purity, uniformity and dependability that deserve your specification. Make sure . . . specify HUSSEY COPPER!

Hussey Copper & Brass

Since 1848

HUSSEY

C. G. HUSSEY & COMPANY
(Division of Copper Range Co.)
ROLLING MILLS AND GENERAL OFFICES
PITTSBURGH 19, PA.

Seven Convenient Warehouses

- CHICAGO
- CINCINNATI
- CLEVELAND
- NEW YORK
- PHILADELPHIA
- PITTSBURGH
- ST. LOUIS

newest aid

to users of fasteners

Everyone who designs, specifies or purchases needs this useful

RIVET SELECTOR!

Handiest selector you ever saw!

Simplifies your job; saves time, speeds choice of right fastener. Easy to read, easy to use, handsomely lithographed in red, white and blue. Shows various tubular and split rivets, part catalog number, normal clinch allowance, size of clearance hole in work and other details to aid your product manufacturing. Sturdily riveted together for lasting use. Write for yours today!

EST. 1919
MILFORD

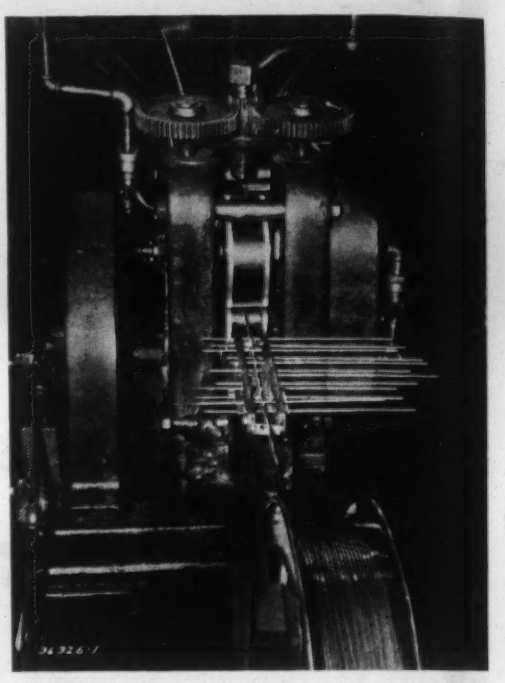
The name to *RIVET* in your memory for fasteners.

THE MILFORD RIVET & MACHINE COMPANY

859 BRIDGEPORT AVENUE, MILFORD, CONNECTICUT
834 ILLINOIS AVENUE, AURORA, ILLINOIS
1110 WEST RIVER STREET, ELYRIA, OHIO
30 PLATT STREET, HATBORO, PENNSYLVANIA
721 SO. PALM AVENUE, ALHAMBRA, CALIFORNIA

News Digest

cially useful in transformer coils such as commonly used in high frequency communications instruments.



Tungsten Carbide Rolls After rolling stainless steel wire in one spot between the rolls for better than a year on a 9-hr day, 5-day week schedule, no sign of wear is visible on these Carboloy tungsten carbide rolls. Previous rolls used by Knowles Loom Reed Works tended to crown the loom reeds if the path of the wire travel through the rolls was not changed every two weeks. Straighteners in foreground flex the wire to remove the cast imparted by rolling.

Materials Trends in Cars Noted

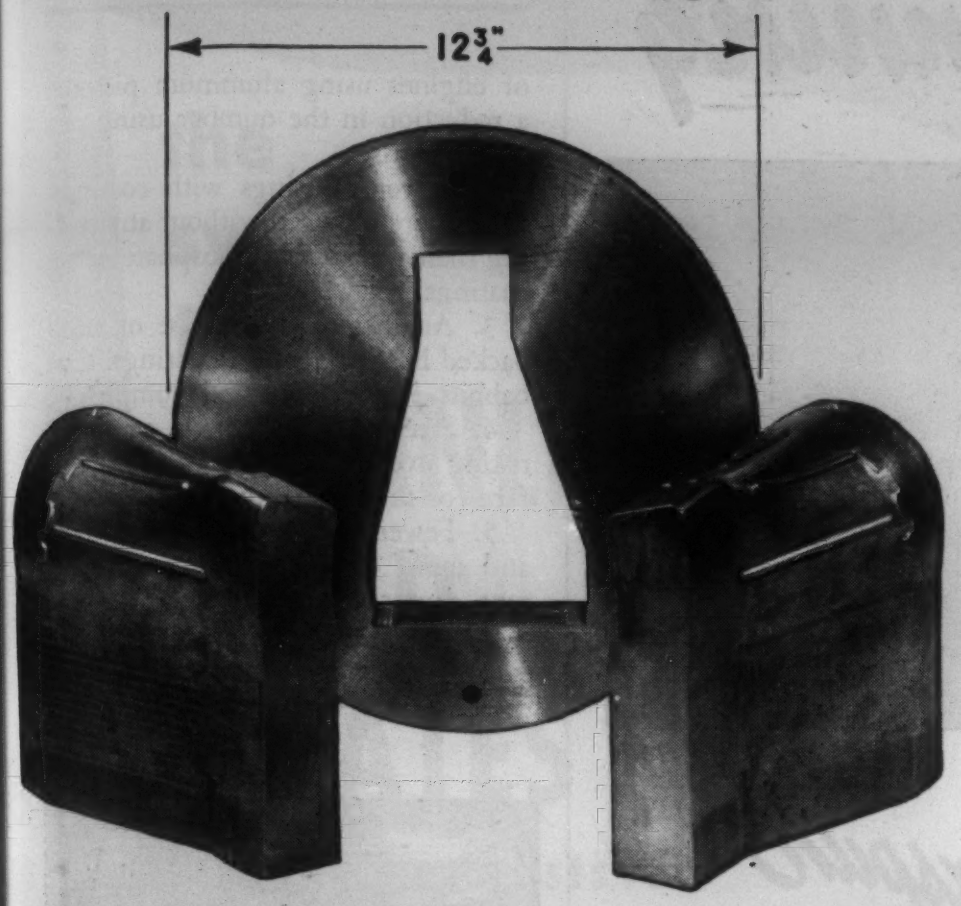
Automotive designers continually reexamine "traditional" materials used in many auto parts. As a result, new materials are specified as models change and, for some parts, a definite trend becomes recognizable.

Several such trends were noted by W. S. James of Fram Corp., who spoke on "engineering highlights" of 1953 passenger cars at an SAE meeting earlier this year.

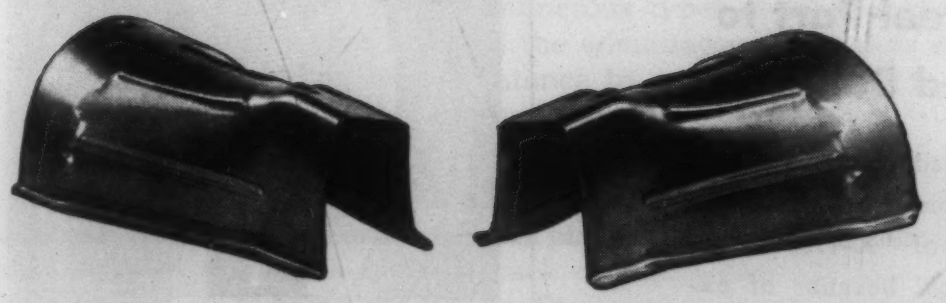
They were:

1. A slight increase in the number

Just this tooling ...



makes 2 drawn parts...



by Hydroforming

What would it cost you to tool this job?

THE CINCINNATI MILLING MACHINE CO.

CINCINNATI 9, OHIO, U.S.A.

HYDROFORM TOOLS ARE CHEAPER TO MAKE

The parts illustrated below are right-hand and left-hand sections of a stainless steel duct—a jet-engine component. The one draw ring shown was used to Hydroform *both* parts, by simply turning it upside down to draw the opposite section. The punches were made of cast iron, machined to shape.

Liberal clearance is permitted between the punch and draw ring—up to 50% of the thickness of the material being drawn. Punches can be made of inexpensive, easy-to-work materials —mild steel, brass, Kirksite, plastics—depending upon the material and shape of the part.

GET BETTER PARTS... BIGGER SAVINGS... BY HYDROFORMING

You'll save on tool costs, *certainly*, by Hydroforming—and produce parts of *higher* quality, in *fewer* operations as well. Bulletin M-1759-1 gives detailed information on this simplified deep drawing process. Write for your copy. For data pertinent to your production, call in a Cincinnati Milling field engineer.

CINCINNATI

Hydroform

HOT Spinning

The Phoenixspun Way

Completes Forming of 3/8-inch Thick "X-4130" Steel Part to Achieve Economy . . . Speed Delivery

The defense-related part here illustrated was originally made from solid bar stock requiring excessive machining hours to rough out. High Material cost of "X-4130" steel was also a factor. Forging was impractical because of excessive die costs and the limited number of pieces required.

Phoenix solved the problem with a combination of hot press forming and hot spinning. Wall thickness was maintained within tolerances which enabled complete final machining, in minimum time.

This method has proved equally adaptable to forming of heavy-gauge experimental development and short run production of aircraft parts, ordnance items — rockets, guided missiles — automotive and truck housings.

●

METAL SPINNING
(Up to 108")

DEEP DRAWING
(To 350 Tons)

WELDING
(Inert Gas, Arc, Oxy-Acetylene)

FABRICATING

ASSEMBLING

Avail yourself of PHOENIX-SPUN counsel and service for *your* forming problems.

SEE OUR CATALOG IN SWEET'S
For Product Designers

Metal Spinning Div., PHOENIX PRODUCTS CO.

4719 N. 27TH STREET • MILWAUKEE 16, WISCONSIN

News Digest

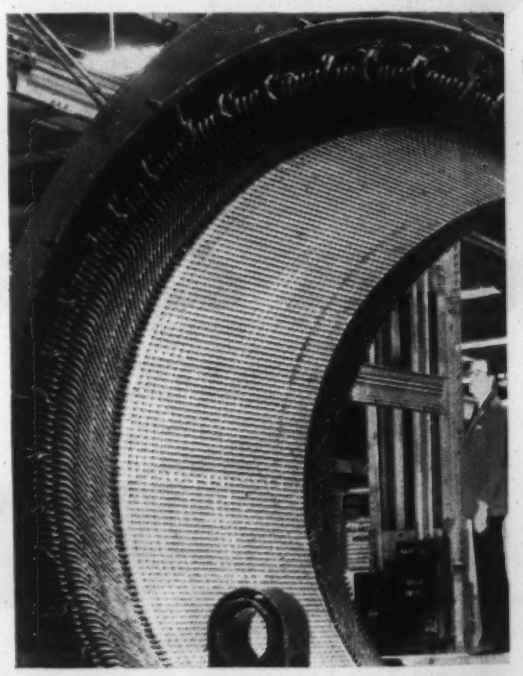
of engines using aluminum pistons; a reduction in the number using cast iron pistons.

2. Fewer oil rings with coatings. Now more are used without any coating than with either phosphate or tin coatings.

3. An increase in the use of steel-backed babbitt for rod bearings. Cast babbitt has disappeared completely.

4. Steel-backed babbitt predominating over lead bronze with babbitt face for main bearings.

5. Fewer cast iron brake drums and more composite or centrifugal-type drums.



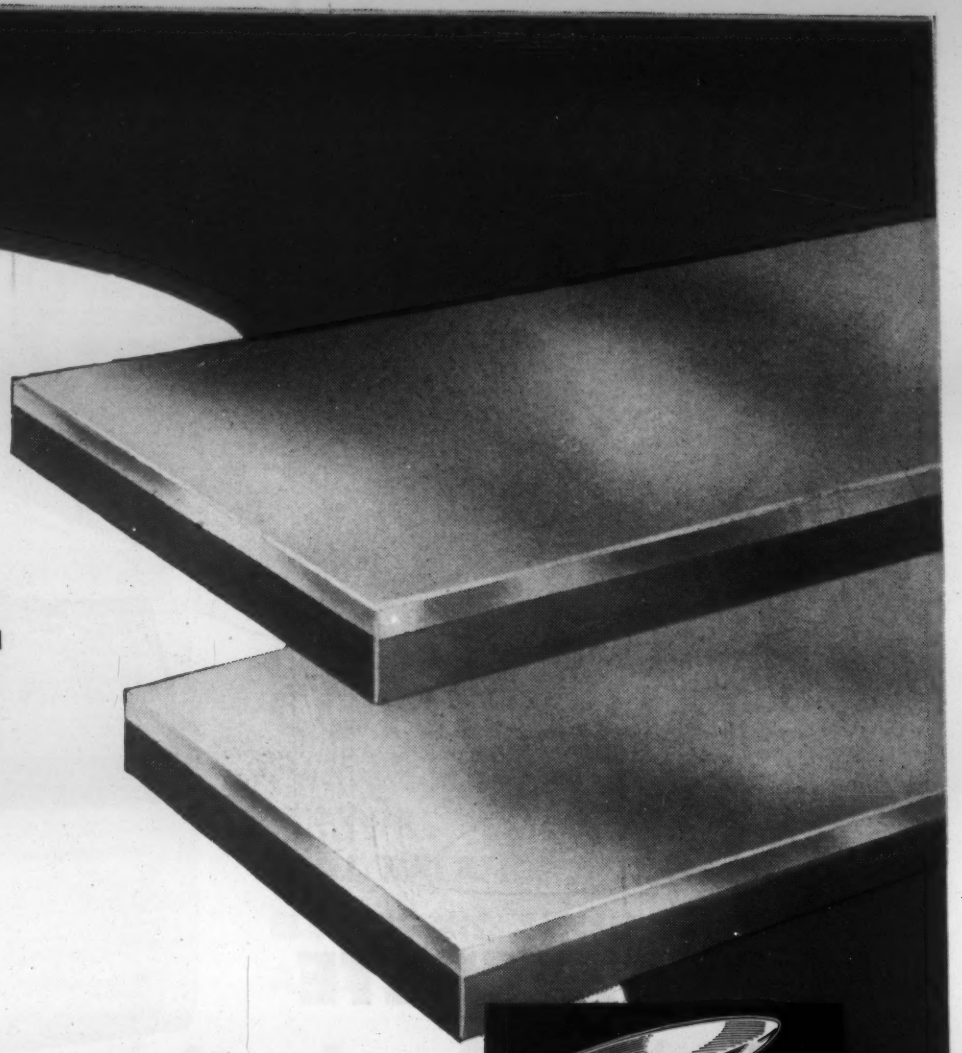
A Giant Stator This 50-ton stator is one of four that will be used at Moffett Field, Calif. to create supersonic air blasts for research in aircraft and guided missile design. Together the wind tunnel motors being built by General Electric will generate a maximum of 216,000 h.p., the largest load ever concentrated on a single shaft. Shown next to the large stator is a 45-lb one for a 5 h.p. motor.

Spark Machining

Another process for shaping metal carbides and other hard materials is now available in this country. Imported from England, it works on the spark machining principle.

The process was developed by

the switch is to STAINLESS-CLAD PLATES



for lower costs... extension of material supplies

More and more, economy-minded buyers are switching to Stainless-Clad Steel Plates as an effective means of extending supplies of critical materials and of beating the high cost of stainless steel.

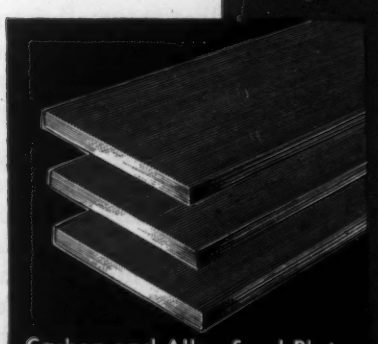
They find that in numerous types of fabrication these plates give them all the advantages of stainless steel, including high resistance to corrosion—yet with considerable savings in material costs.

Stainless-Clad Plates made by Claymont are a composite of stainless steel permanently bonded to carbon or alloy steel plate. They're easy to fabricate; will not buckle, crack or peel under the severest forming operations. Stainless cladding may be of any specified percentage of total plate from 10% to 50%.

Other Claymont products include Flanged and Dished Heads, Alloy and Carbon Steel Plates, Large Diameter Welded Steel Pipe.

To order, write or call Claymont Steel Products Department, Wickwire Spencer Steel Division, Claymont, Delaware.

Flanged and Dished Heads



Carbon and Alloy Steel Plates

Large diameter steel pipe

THE COLORADO FUEL AND IRON CORPORATION—Denver, Colorado
THE CALIFORNIA WIRE CLOTH CORPORATION—Oakland, California
WICKWIRE SPENCER STEEL DIVISION—Atlanta • Boston • Buffalo • Chicago • Detroit • New York • Philadelphia
CANADIAN OFFICES: Toronto • Winnipeg • Edmonton • Vancouver

CLAYMONT STEEL PRODUCTS

PRODUCTS OF WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL AND IRON CORPORATION

CF&I

J-M BLAZECRETE builds longer lasting refractory linings...

That's why it pays you to use this hydraulic setting refractory for temperatures to 3000F

Blazecrete* linings last longer because they resist spalling, withstand slagging action, and are not harmed by rapid temperature changes.

Thus you cut down on refractory maintenance costs—and you save on labor costs, too, because Blazecrete goes on fast. For troweling, just mix Blazecrete with water as you'd mix ordinary concrete . . . then slap-trowel it in place. When gunned, it adheres readily with a minimum of rebound loss. Either way, Blazecrete may be applied easily without laborious ramming or tamping.

Three types of hydraulic-setting Blazecrete are available. All harden on air curing, do not require prefiring. They are furnished as a dry mix—can be stored safely for use as needed.

3X BLAZECRETE—For temperatures through 3000F. Unusually effective for heavy patching, especially where brickwork is spalled or deeply eroded. Excellent for forge furnace linings, lime kilns, burner blocks, soaking pits, and industrial boilers.

STANDARD BLAZECRETE—For temperatures through 2400F. Makes repair work easier and less costly. Can be used by boiler manufacturers to replace fire clay tile in wall construction. Suitable for use in combination with 3X Blazecrete and L. W. Blazecrete.

L. W. BLAZECRETE—For temperatures through 2000F. An insulating refractory . . . light in weight, low in thermal conductivity. Adaptable and economical for many other applications.

Send for Brochure RC-28A on Blazecrete and its companion material, Firecrete*. . . the hydraulic-setting castable refractory for making special shapes and linings. Write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay St., Toronto 1, Ontario.

*Reg. U.S. Pat. Off.

Whether you gun it... *or slap-trowel it...*

Johns-Manville **BLAZECRETE**

BUILDS BETTER REFRACTORY LININGS

News Digest

Sparcatron, Ltd., and has been used extensively in Europe. It is claimed that in some hard substances the equipment can bore holes having diameters smaller than 0.01 in. Unlike some of the processes used to shape hard materials, the Sparcatron method generates no heat.

Nylon Wins Again

Good resistance to sea water erosion may win nylon a new application.

The Bureau of Ships subjected sample globe and gate valves incorporating nylon trim to extensive tests with high-velocity sea water flowing through them. First reports indicate a high degree of resistance to erosion. A nylon insert in the disk of a 4½-in. globe valve was found to be in excellent condition after 18 months service, while a monel valve seat in the valve was severely corroded.

News of Engineers

The following appointments have been announced by Westinghouse Electric Corp.: *W. Allen Brecht* has been named consulting engineer for the Atomic Power Div.; *John H. Chiles, Jr.*, manager of engineering, Transformer Div., has been named chairman of the American Standards Assn.'s Sectional Committee C-57 on Transformers, Regulators and Reactors; *I. G. Fox* has been appointed manager of materials for the Transfomer Div. Four men have been appointed to key posts in the newly formed Atomic Equipment Dept.: *Leon B. Dorsner*, supervisor of manufacturing; *Ralph M. Yearick*, supervisor of production; *James L. Ackerman*, administrative assistant to the department manager; and *Benjamin Cametti*, manager of the pump engineering section. The board of directors elected five vice presidents at the annual organization meeting. They are: *Bruce D. Henderson*, general manager, purchases and traffic, elected vice president in charge of purchases and traffic; *William C. Rowland*, vice president in charge of the Manufacturing and Repair Div.; *Franklin L. Snyder*, assigned to the staff of the executive vice president, Defense Products Divisions; *C. Swan Weber*, manager, Eastern district, vice

REQUIRE PRECISE TEMPERATURE CONTROL?

Thermo Electronic TEMPERATURE CONTROLLERS

provide
NULL BALANCE ACCURACY
ELECTRONIC SENSITIVITY
AND SPEED

AT LOW COST

Now, with Thermo Electronic Controllers, thermocouple and resistance bulb types, you can afford accurate, automatic temperature control on processes and equipment operating between −100°F and 3000°F. The two-position control action is continuous and high speed, only one part—a magnetic control relay—moves positively when the process calls for a change of heat. Both types of controllers incorporate a null balance circuit for high measuring accuracy with an electronic control system for sensitivity and speed. Calibration is guaranteed to within plus or minus ¼ of 1% of full scale range. Bright signal lights indicate temperature conditions and are clearly visible over wide angles and great distances.

Outstanding features of Thermo Electronic Controllers are simplicity of design and sturdy and compact construction. They are easy to install, economical to operate, and require little maintenance. Severe vibration or mechanical shock will not affect the measuring accuracy or control sensitivity.

TELL US ABOUT YOUR TEMPERATURE CONTROL PROBLEM OR WRITE FOR

Thermocouple Pyrometer Controller Bulletin 50G
Resistance Bulb Controller Bulletin 55G

OTHER THERMO ELECTRIC PRODUCTS

Thermocouples
Protection Tubes
Quick Coupling Connectors
Thermocouple and Extension Wires
Resistance Bulbs
Connector Panels

Thermo Electric Co., Inc.

FAIR LAWN NEW JERSEY

MISCO *Flexible* FURNACE HEARTHS

Heat Resisting · Wear Resisting · Shock Resisting

Here it is...

MISCO B (25 Cr—12 Ni) ALLOY HEARTH

An Effective, Economical METAL HEARTH

The Misco Flexible Furnace Hearth is made in simple 4″ x 4″ interlocking units for assembling to any size. Flat on top and strongly ribbed underneath, it will not distort like a large one-piece plate. Any warpage is limited to a 4″ x 4″ local area and is not communicated to the hearth as a whole.

If the underlying brickwork is flat to start with, the Misco Hearth will remain flat and level until the supporting brickwork itself becomes displaced.

The Misco Flexible Hearth resists wear and impact, is shockproof and practically indestructible. It will protect the hearth brickwork up to 2200°F., and can be used over and over again.

Michigan Steel Casting Co.

One of the World's Pioneer Producers of Heat and Corrosion Resisting Alloys

1999 GUOIN STREET
DETROIT 7, MICHIGAN

MISCO
Heat and Corrosion Resistant Alloys

News Digest

president in charge of the Washington office; *Robin S. Kersh,* executive vice president of Westinghouse Electric International Co., vice president of the parent company in charge of Eastern district; and *Leslie E. Lynde,* manager, Aviation Gas Turbine Div.

Risto P. Lappala of Bjorksten Research Labs, Inc., has been promoted from research chemist to group leader, in which capacity he will direct research on metal-plastic combinations for structural applications.

Three scientists have recently joined the staff of the metals research dept., Armour Research Foundation, Illinois Institute of Technology. *Lyle L. Clark,* former assistant superintendent of melting for the Buick Motor Div. foundry, has been named supervisor of the foundry section here; *C. Robert Lillie,* former project engineer for Standard Oil Co. of Indiana, and *Jack Giddens,* former chief metallurgist for the Perfect Circle Co., have been appointed research metallurgists. *Dr. Donald H. Madsen,* formerly research engineer at the Borg-Warner central research laboratory, has been named a research engineer in the heat-power dept, and *Erich H. Koeller* and *Radoslav T. Mijanovich* have been appointed research engineers at the foundation.

General Electric Co. has announced the following appointments: In the Switchgear and Control Div., *Clarence E. Burke, H. Frank Hentschel* and *Reginald H. Jones* were named general managers for the newly established High Voltage Switchgear Dept., Medium Voltage Switchgear Dept. and Low Voltage Switchgear Dept. respectively. *Vernon L. Cox* and *Edwin M. Bramwell* were made managers of staff departments. *F. H. Evans* has been named manager of manufacturing for the Welding Dept. *Thorn L. Mayes* has been appointed general manager of the newly established Integral Motor Dept. *Harry A. Winne,* vice president of engineering, has been named to a new post performing special assignments for the G-E president. Mr. Winne's move is in anticipation of his retirement from the company in the latter part of the year. *Clarence H. Linder,* vice president and general manager of the Major Appliance Div., will succeed Mr. Winne; *Charles K. Rieger,* vice president and general manager, Small Appliance Div., will assume Mr. Linder's former post, and *Willard H. Sahloff,* general manager of the Electronic Div.'s radio and television dept., will replace Mr. Rieger in the Small Appliance Div. *Morrough P. O'Brien,* Dean of the College of Engineering, University of California, has accepted a position as consulting engineer to the company's Aircraft Gas Turbine Div., while on leave from the University.

Louis L. Potomac, widely known industrialist, was elected president of Reflin Co.

GLOBE Seamless
GLOWELD Welded

- **Resistance to Corrosion**
- **Strength at High Temperatures**
- **Resistance to Oxidation at High Temperatures**
- **Ease of Fabrication**

TYPICAL ANALYSES AND TYPES:

302	309S	316Cb	330	410
302B	309Cb	317	347	430
304	310	321	403	443
308	314	329	405	446
309	316	INCONEL * — NICHROME **		

**Registered U.S. Trade-Mark* ***Trade-Mark Reg. U.S. Pat. Off. D-H Co.*

Globe produces more than 26 standard analyses of stainless steel tubes — also special analyses when required. Because varying analyses have widely varying service characteristics, Globe will make recommendations only after careful study of your particular problem.

GLOBE

specialization...

meets your exact requirements in

STAINLESS STEEL TUBES

Write for Bulletin 333 — Corrosion and Heat Resisting Steel Analyses Chart — a valuable reference tabulation of stainless steel analyses as produced by various manufacturers.

Piercing, rolling and reduction of seamless tubes is closely monitored from this control room — typical of the highly specialized equipment in the Globe mill.

SIZE RANGE:

Globe seamless stainless steel tubing may be had in sizes from ½ inch to 6 inches O.D., and in pipe sizes ⅛ inch to 6 inches, standard, extra strong and double extra strong weights.

Gloweld electric welded stainless steel tubing is available in sizes ranging from ¼ inch to 5 inches O.D. inclusive; in standard weight pipe (schedule 40) sizes ⅛ inch to 2 inches — lightweight pipe (schedule 5 and 10) ⅛ inch to 4½ inches inclusive.

TOLERANCE RANGE:

All stainless tubing furnished to standard A.S.T.M. specifications unless otherwise specified to suit your particular application requirements.

Globe specialization gives you uniform high quality...

Precision checks — and re-checks — at every stage of production insure Globe stainless steel tubes that meet *your* exacting specifications. For more than thirty years, specialization in production of steel tubes has key-noted all Globe research, engineering and mill operations. Write for the Globe Stainless Steel Tubes catalog.

GLOBE STEEL TUBES CO., Milwaukee 46, Wis.

Chicago — Cleveland — Detroit — New York — Philadelphia — St. Louis — Denver — Houston — San Francisco — Glendale, Cal.

Producers of Globe seamless stainless steel tubes — Gloweld welded stainless steel tubes — alloy — carbon seamless steel tubes — Globeiron (high purity ingot-iron) seamless tubes — Globe welding fittings.

"We minimized scrap loss...
...cut fabricating costs 23.9%
by letting
Fansteel
fabricate our
TUNGSTEN and MOLYBDENUM
COMPONENTS

A short molybdenum rod (1) was hot forged to form basic cone (2), and the part (3) was finished by machining and drilling.

More and more tungsten and molybdenum users are finding Fansteel fabrication the answer to complicated and costly production problems. Fansteel's long-experienced engineers and technicians not only recommend the material to be used but also the shape best adapted to solve a specific problem. Why not use Fansteel fabrication to your advantage, too? Fansteel will help you effect important cost savings by eliminating the scrap and reject problem, minimizing inspection costs, and releasing equipment and personnel for other work.

FANSTEEL WORLD'S LARGEST PRODUCER OF REFRACTORY METALS

Write for the informative booklet: "FANSTEEL TUNGSTEN AND MOLYBDENUM"

TUNGSTEN & MOLYBDENUM

22503C

Fansteel Metallurgical Corporation NORTH CHICAGO, ILLINOIS, U.S.A.

News Digest

Jack & Heintz, Inc. has named *Joseph E. Mulheim* to the position of chief engineer.

John W. Putnam has been appointed chief metallurgist at Engineered Precision Casting Co.

Judson C. Travis has been elected president of Handy & Harman. During the last year Mr. Travis served as vice president and general manager, and prior to that he had been executive vice president of the company.

William O. Wilson, commercial vice president, Worthington Corp., has retired after 53 years of service with the company and its predecessor companies.

United Chromium, Inc. has appointed *Frank Passal,* a member of its research staff, to assistant director of research, Plating Div.

Phil Watson was recently appointed manager, Welding Div., P. R. Mallory & Co. Former Welding Div. manager, *Bill Fetter,* was named to manage the Switch Div.

Appointment of *R. S. Bright* to general manager of Chrysler Corp.'s Indianapolis plant has been announced. Appointment of *Carl J. Demrick* to the newly created position of general manufacturing manager of the company's Plymouth Div. has also been announced.

General Gas Corp. has appointed *Ray L. Farabee* as a vice president of its subsidiary, Delta Tank Manufacturing Co., Inc. Mr. Farabee will be in charge of production, engineering, research and development.

Appointment of General *Harlan L. Mumma* as executive vice president of Zenite Metal Corp. has been announced.

Servel, Inc. has named *John H. Jennings* as chief engineer in charge of all air-conditioning activities.

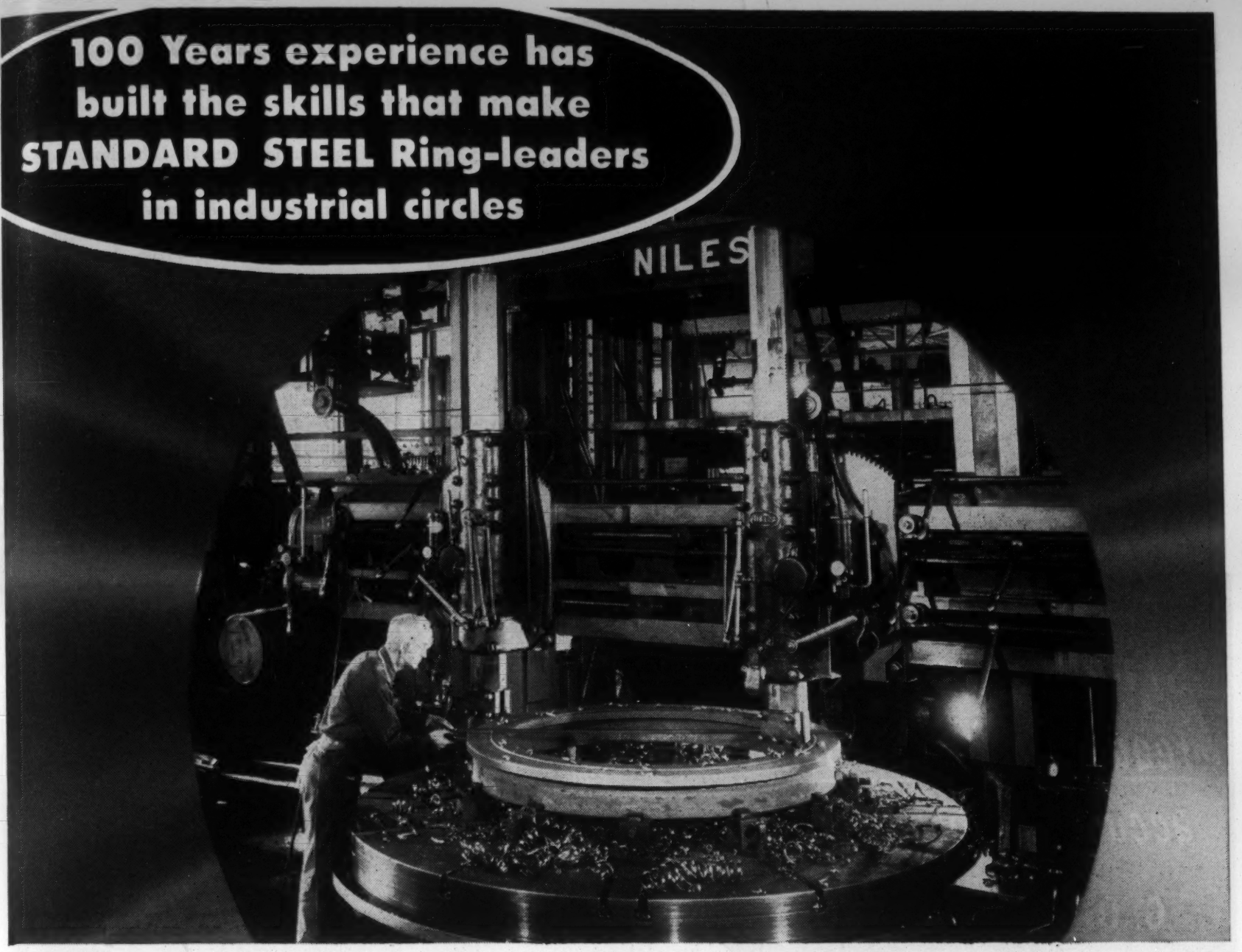
Dr. *Gerald V. Kingsley* has been named research supervisor and *Edward O. Falberg* has been selected production metallurgy supervisor at Bohn Aluminum and Brass Corp., Research Div.

After 46 years as executive head of Williams and Co., *Harold E. Williams* has retired from active duties as president and has become chairman of the board. Vice president *Hugh C. Armstrong* has been elected president, and *C. C. Kleinschmidt,* vice president and assistant general manager.

Robert E. Parkinson has been appointed supervisor of materials research for The Kawneer Co.

Acme Steel Co. has announced the appointment of *Walter F. Hinkle* as director of engineering and research. In this capacity, Mr. Hinkle will direct all engineering activities of the company. *James N. Wognum* has been named chief engineer of the company's newly created

100 Years experience has built the skills that make STANDARD STEEL Ring-leaders in industrial circles



Photographed through one of the smallest forged rings made by Standard Steel, this 120-inch Niles vertical boring mill is machining a gun base mount stand ring which will have a finish O.D. of 69½ inches, which operator is checking.

Experience builds skill, and skilled manufacturing produces quality products. Standard Steel Works has had 100 years of experience to build the manufacturing skills that produce finest quality weldless rings and flanges.

Standard Steel's experience has developed to a high degree the skills that make possible accurate quality control of the analysis and physical properties of their steels . . . close control of heat treatment, rolling and other forming operations . . . precise machining to assure finishing of rings and flanges to exact specifications.

You can't ignore experience as a guide to quality, and Standard Steel's experience is hard to match . . . still another reason why you can always rely on Standard Steel for rings and flanges.

ONE OF SIX REASONS why you should call Standard Steel for forgings and castings.

1. Experience—produced by skilled workmen with 20 to 40 years experience.
2. Quality Steel—through production of own steel by acid process.
3. Uniformity—assured by precise control of forging and rolling operations.
4. Fast Service—a vital factor in the continuing growth of Standard Steel for over 150 years.
5. Testing—radiographic tests, tensile tests, hardness tests, ultrasonic probing of internal structure, etc.
6. Capacity—unsurpassed ability to produce forgings and castings of unusual sizes and shapes, such as weldless rings all the way up to 144″ O.D.

For more information, write Dept. 8523

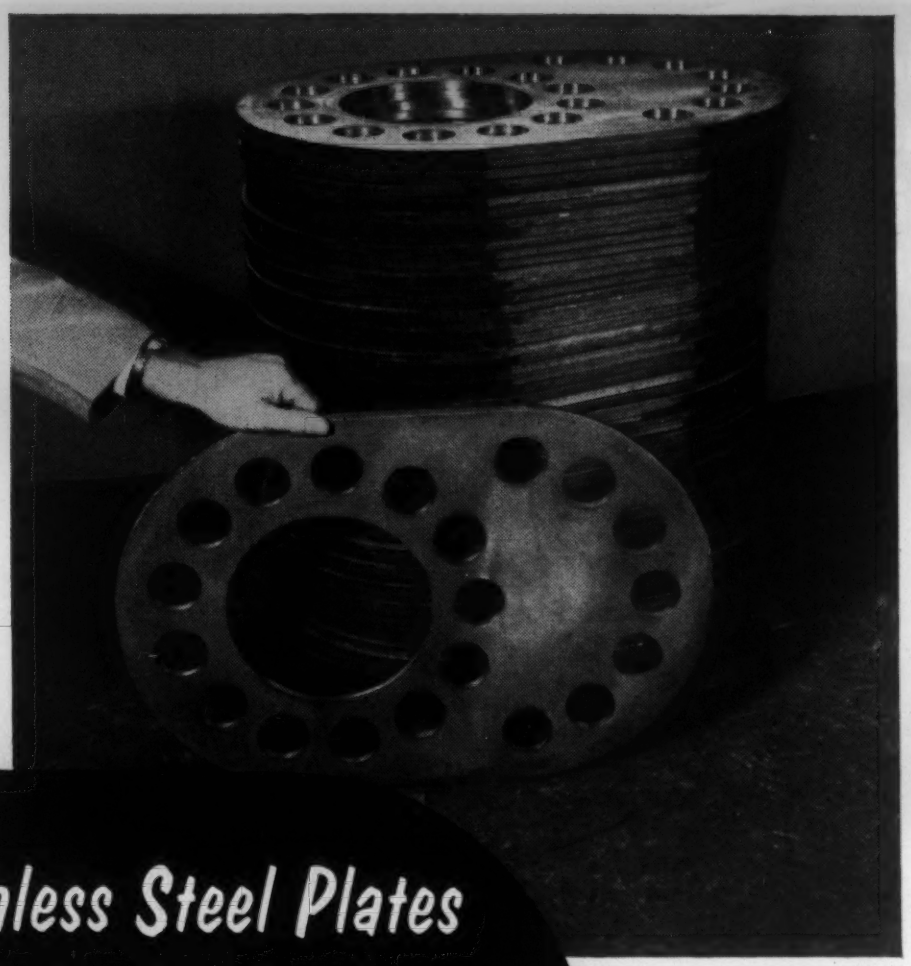
Standard Steel Works Division

BURNHAM, PENNSYLVANIA

BALDWIN · BLH · LIMA-HAMILTON

BALDWIN-LIMA-HAMILTON

General Offices: Philadelphia 42, Pa. • Offices in Principal Cities



Stainless Steel Plates
ready for fabrication
accurately produced by
G. O. CARLSON, INC.

FABRICATORS time and time again turn to G. O. Carlson, Inc. for what they need in stainless steel. These fabricators know that Carlson's experienced specialists in Engineering and Production plan their work . . . for accuracy, for economy, for prompt delivery.

The patterns illustrated are typical. Made from Type 304 stainless, these blanks are sheared and sawed from ⅜" plate to 16½" x 23½" dimensions. One 8⅛" diameter hole and twenty 2 13/32" diameter holes were machined in these patterns to give the fabricator pieces requiring only a minimum of additional work before actual fabrication.

It is this "done right" aspect of Carlson workmanship that has built a service on which customers fully depend. For your work in stainless, let Carlson do it—and be completely satisfied. We'll gladly answer your inquiry without delay.

Stainless Steels Exclusively

G. O. CARLSON, INC.

PLATES • FORGINGS • BARS • SHEETS (No. 1 Finish)

THORNDALE, PENNSYLVANIA

District Sales Offices in Principal Cities

News Digest

Engineering Research Laboratory, located at 7439 S. Ashland Ave., Chicago.

Dr. *Emmette F. Izard,* research associate of du Pont Co.'s Film Dept. Research Laboratory, has been named recipient of the 23rd annual award of the Jacob F. Schoellkopf medal of the Western New York Section, American Chemical Society, for his outstanding contribution to industrial chemistry.

John R. McVeigh has joined the Research & Development staff of Alloy Engineering & Casting Co. as chief engineer. For the past three years, Mr. McVeigh has been research engineer for Kennametal, Inc.

Robert H. Marsh has been promoted to the position of assistant chief engineer at the Lowell plant, Raytheon Manufacturing Co., Missile & Radar Div.

Samuel P. Felix has been named general manager of the De Laval Turbine Pacific Co.

N. George Belury has been elected a vice president of American Brake Shoe Co. Mr. Belury will continue to serve as president of the Engineered Castings Div.

W. S. Simpson has been elected vice president in charge of the Raybestos Div., Raybestos-Manhattan, Inc.

DeWitt O. Myatt has been named to the newly created post of manager of development, Atlantic Research Corp. Mr. Myatt joins the company after seven years of service with the American Chemical Society as managing editor of *Industrial and Engineering Chemistry.*

Walter F. Greenwood, formerly associated with the Air Materiel Command, U. S. Air Force, has joined Cleveland Welding Co. as assistant to the president.

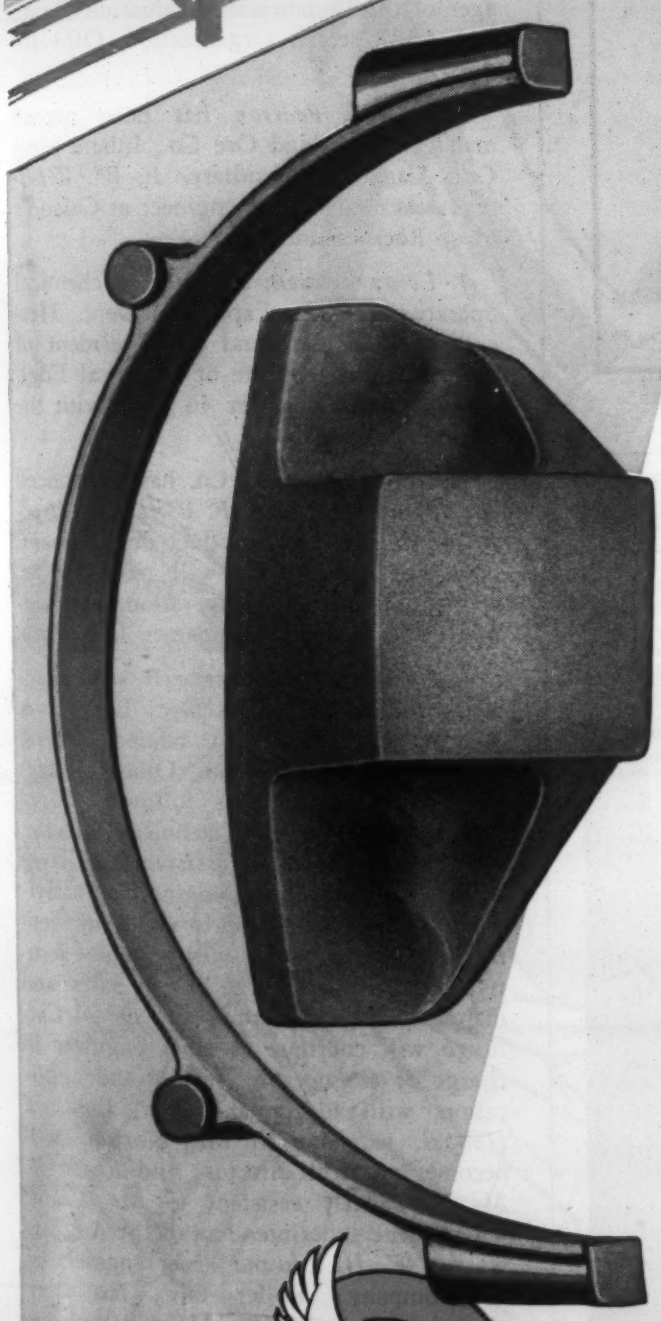
Robert C. Abrahamsen has been appointed general manager of Alpha Tool & Supply Co.

The following appointments have been announced by General Electric Co.: *H. J. Service* as manager-manufacturing for the Accessory Turbine Section, Aircraft Gas Turbine Div.; and *Francis K. McCune,* as general manager, Atomic Products Div. In his new capacity, Mr. McCune will be one of the company's top executives in the field of atomic energy, being responsible for the company's far-flung 11,000-man atomic energy activities. *Joseph L. Geenens,* formerly superintendent of the Alnico permanent magnet section of Carboloy's operations in Schenectady, has been named manufacturing superintendent of the Edmore, Mich. plant of Carboloy Dept.

Woodrow W. DeMuth has been made superintendent of plant engineering at Servel, Inc.

W. J. Kunz, Jr., Bendix Aviation Corp., received the Wright Brothers Medal of the Society of Automotive Engineers for

Make Production Line SAVINGS with PERMITE ALUMINUM CASTINGS



Faster production is gained by manufacturers in many industries when they change to Permite Aluminum Castings for component parts for their finished products. Light-weight Permite Aluminum Castings bring easier, faster handling on the assembly line. Permite users receive castings of uniform quality, thus avoiding interruptions caused by defective or substandard parts. Deliveries, too, are always on schedule; parts are on hand when needed.

The long experience, flexibility and extensive facilities of the Permite organization afford a source of supply for aluminum castings — permanent mold, semi-permanent mold and sand mold — that manufacturers in the metalworking industry have found they can depend upon to keep production moving smoothly.

Why not investigate the advantages offered by Permite? Send blueprints or specifications on your parts requirements for prompt recommendations and cost estimates. There is no obligation to you.

ALUMINUM INDUSTRIES, INC.

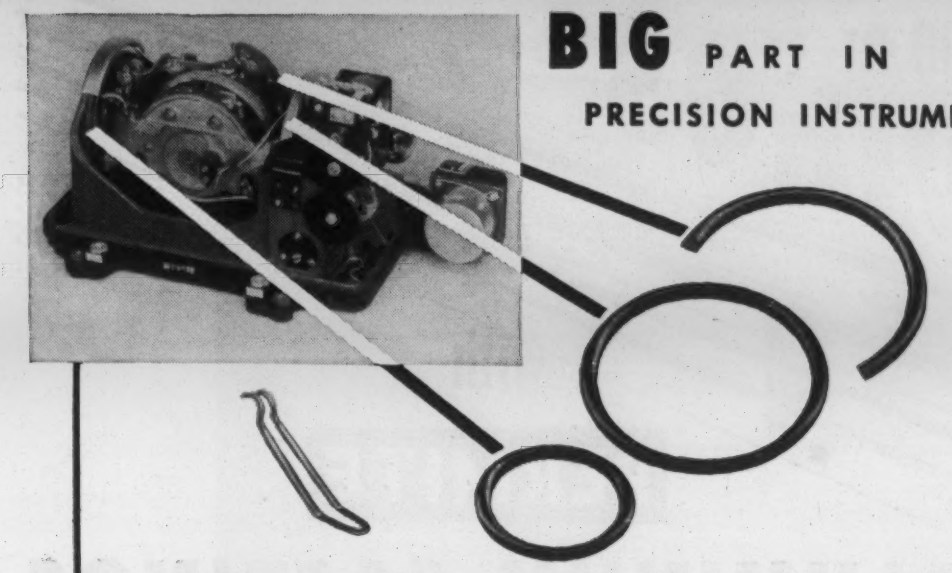
Cincinnati 25, Ohio

Detroit: 908 New Center Building
New York: 9 Rockefeller Plaza
Chicago: 64 E. Jackson Boulevard

PERMITE Aluminum Castings

ALUMINUM PERMANENT MOLD and SAND CASTINGS . . . HARDENED, GROUND and FORGED STEEL PARTS

NEY'S SMALL PARTS PLAY A **BIG** PART IN PRECISION INSTRUMENTS



This Cageable Vertical Gyro, for use in stabilization and control systems of aircraft, guided missiles and radar scanners, manufactured by the Aeronautical Division of the Minneapolis-Honeywell Regulator Co., contains three doughnut potentiometers wound with NEY-ORO G high strength, precious metal resistance wire, contacted with wiper brushes of Paliney #7* (illustrated at far left).

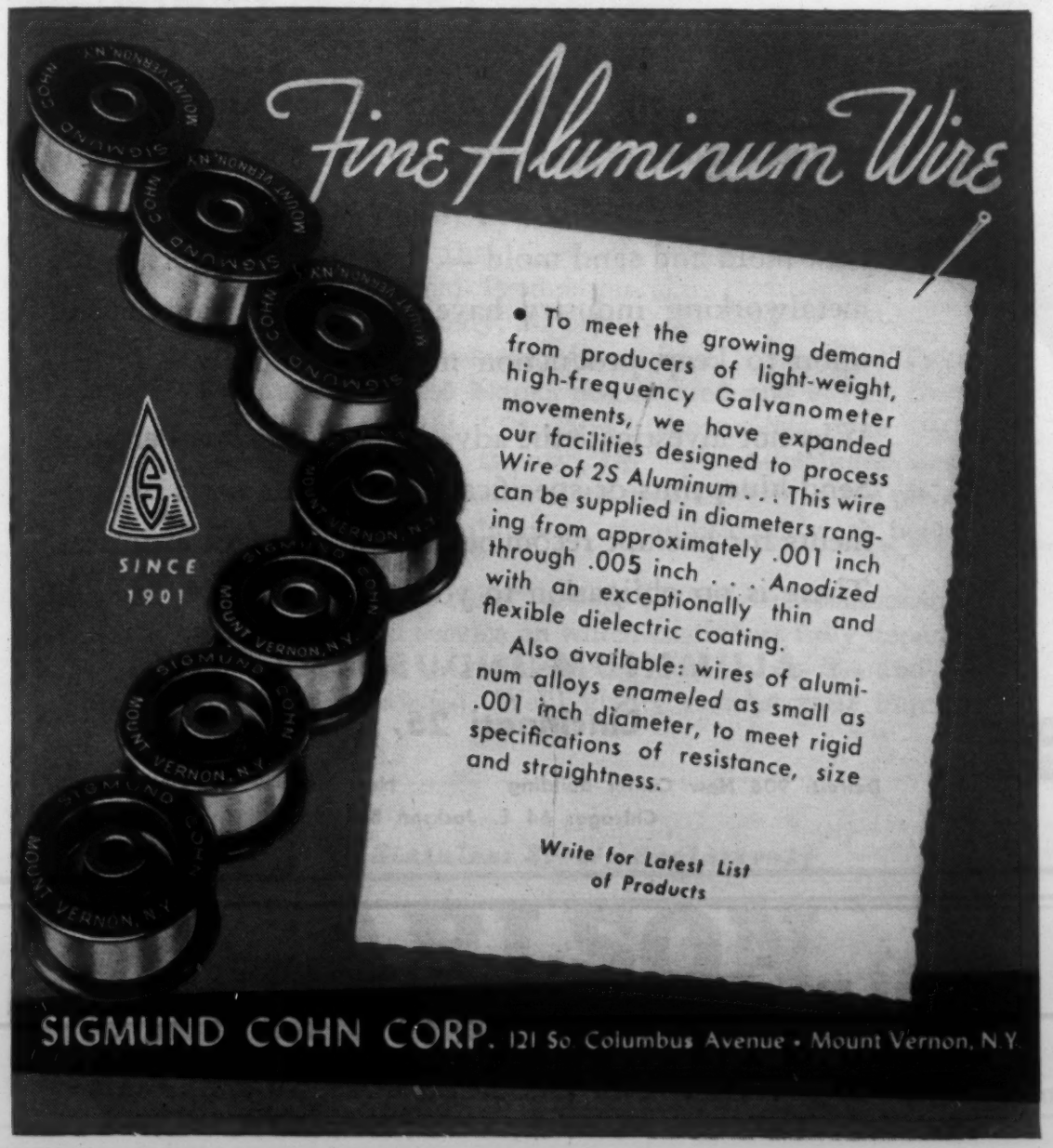
Many other manufacturers of precision instruments specify Ney precious metal component parts for use as slip rings, brushes, wipers, commutator segments, etc. Ney Precious Metal Alloys have specific qualities which mean greater accuracy, longer life and resistance to most corrosive industrial atmospheres.

Call or write the Ney Engineering Department for assistance with your instrument problems.

*Registered trade mark

THE J. M. NEY COMPANY • 105 Elm Street, Hartford 1, Conn.
Specialists in Precious Metal Metallurgy Since 1812

13NY53B



News Digest

1952 at the Aeronautic Meeting dinner on Apr. 23. The award goes to Mr. Kunz for his paper, "A New Technique for Investigating Jet Engine Compressor Stall and Other Transient Characteristics".

Two major organizational changes in the Naugatuck Chemical Div., U. S. Rubber Co. have been announced. Dr. *Earle S. Ebers,* formerly sales manager, Kralastic and Vibrin resins, was named director of research and development to replace *M. G. Shepard,* who has retired. Dr. *D. Lorin Schoene,* formerly manager of plastics development, was appointed to the post of assistant director of research and development.

L. R. McClary has been appointed manager of the Commercial Evaluation Dept., General Research Organization, Olin Industries, Inc.

Philip D. Pearson has been named manager of Caland Ore Co., Inland Steel Co.'s Canadian subsidiary. *E. W. Whitman* was named chief engineer at Caland's Steep Rock operations.

J. Leroy Bennett, manager of chemical operations for the Explosives Dept., Hercules Powder Co., and past president of the American Institute of Chemical Engineers, has retired after 46 years with the company.

Dearborn Chemical Co. has announced the appointment of *J. F. Wilkes* as director of research and product development, in which capacity he will maintain responsibility for the operation and administration of the company's laboratory.

J. E. Brinckerhoff, formerly sales manager of the Refractories Div., Babcock & Wilcox Co., has been named general manager of the Division. Other changes in the Division are as follows: *C. L. Norton, Jr.,* formerly technical director, will become executive assistant in charge of all development and engineering activities; *Carl Claus,* formerly superintendent of the Augusta works, will become executive assistant in charge of all sales and manufacturing operations; *J. D. McCullough* will continue as chief engineer in charge of engineering, service and application, with additional duties; *Bradford Hooper,* assistant to Mr. Norton, will become technical director; and *Royce K. Mack,* formerly assistant to Mr. Claus, will become superintendent of the Augusta works. *W. H. Rowand,* chief engineer of the company's Boiler Div., has been elected a vice president. He will continue to hold the post of divisional chief engineer.

Tom R. Smith, director of research and development for the Maytag Co., has been named vice president in charge of research and development.

Kenneth M. Leghorn, executive vice president of Sun Tube Corp., has been elected president of the company.

A. O. Smith Corp. has announced the

there's more to rubber than

Stretch

The most important factor about any rubber part is its ability to do the job for which it is intended. While the slingshot requires stretch only, industrial rubber parts must have resistance to oils, chemicals, weather, temperature extremes or combinations of these deteriorating factors.

STALWART engineers have the experience and facilities to compound stocks and fabricate rubber parts which will serve your needs best. From more than 500 different rubber stocks at their disposal they can mold, extrude, die-cut, lathe-cut or mandrel-build shapes to meet individual, S.A.E. or A.S.T.M. specifications. These parts will retain their desirable physical, chemical and dielectric properties under severe operating conditions and give optimum performance in each application.

Specify STALWART rubber parts for that one essential quality . . . the ability to do a job . . . best.

1058-SR

Write today for Catalog 51SR-1 for complete information.

STALWART RUBBER COMPANY

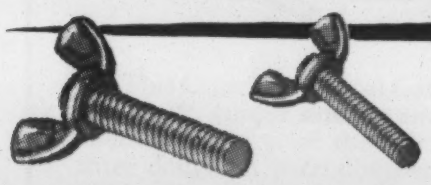
200 Northfield Road • Bedford, Ohio

GRC

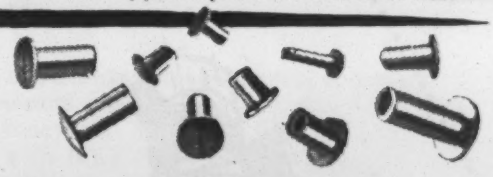
ZINC ALLOY
FASTENINGS

GRC WING NUTS
Exclusive, finger-grip design; easy to assemble, disassemble; brightly finished; clean threads.

GRC CAP NUTS
Die cast, not turned! Free of tool marks and cut-off burrs; class 2 threads tapped square with face of nut.



NEW! GRC WING SCREWS
A steel screw combined with GRC's attractive finger-grip wing-nut.



GRC SMALL TUBULAR RIVETS
Die cast, not headed! Closer tolerances, more uniform heads for greater riveting efficiency. Dia. up to 9/64"; lengths to 5/16".

- RUSTPROOF
- DEPENDABLE
- DURABLE

Gries die cast zinc alloy fastenings are durable, rustproof ... economical, too! All Gries fastenings may be used without protective finishes in most applications. Furnished in all commercial finishes when desired. Prompt delivery on standard sizes—specials to order.

WRITE TODAY FOR SAMPLES AND PRICES

GRIES REPRODUCER CORP.
84 Willow Ave., New York 54 • Phone MOtt Haven 5-7400

Davidson
RUBBER COMPANY
BOSTON 29 MASSACHUSETTS

WRITE FOR INDUSTRIAL CATALOG

INDUSTRIAL RUBBER PRODUCTS

Solid, hard or sponge rubber parts molded to customers specifications from natural, synthetic and reclaimed rubber

Davidson RUBBER COMPANY
"Established 1857"
BRIGHTON STREET Department 4 BOSTON 29, MASS.

News Digest

appointment of *George M. Graetz* as manager of the new Eastern plant of its Welding Products Div., now under construction at Lancaster, Pa.

Oliver G. Dumont has been named superintendent of the electrical departments at Allis-Chalmers Norwood works, succeeding *G. C. Vogel,* who recently became general superintendent.

Died.....*Stewart A. Millar,* new products development engineer for the Detrex Corp.

.....*James W. McLaughlin,* vice president, Union Carbide and Carbon Corp.

.....Vice Admiral *Carl F. Holden,* (USN retired), president of the Federal Telecommunication Labs., Inc.

News of Companies

Babcock & Wilcox Co. has announced the establishment of an *Atomic Power Div.*

Formation of *Precision Castparts Corp.,* and full scale commercial operation of the company's plant at 8705 S. E. 13th Ave., Portland 2, Ore., has been announced by Joseph B. Cox, president of the new firm.

Rotex Punch Co., Inc., San Leandro, Calif., is the first firm in the world licensed to make tools for Williams Metalacing, the new one-step method of buttoning sheet metal together.

Announcement of a new engineering organization in the metal stamping field to be known as *The Leake Engineering Co.* has just been released. The new company will be located in Monroe, Mich., and will operate as an entirely separate unit from the *Leake Stamping Co.* of that city.

Industrial Equipment Co. has changed its name to *Industrial Crane & Hoist Corp.*

Acquisition of a new building at 1119 E. Ten Mile Rd., in the industrial area of Hazel Park, Mich., to house production facilities of its new *Shear-Speed Chemical Products Div.,* has been announced by *Michigan Tool Co.*

A three-day seminar on corrosion resisting process equipment highlighted the official opening of the newly expanded and completely remodeled research building of *The Pfaudler Co.* in Rochester.

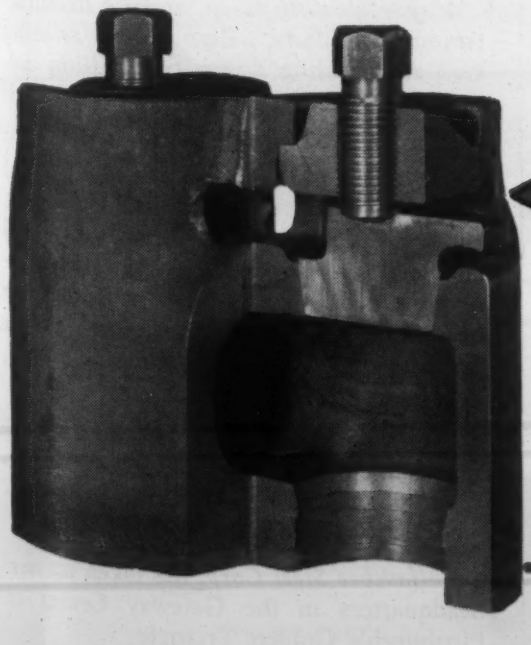
Opening ceremonies were recently held for the new *Central Research Laboratories* of *American Smelting and Refining Co.,* located in South Plainfield, N. J.

W. M. Chace Co. has completed a new

Spots Usually Spell Trouble

While that's true of little boys *and* castings, the condition is not equally obvious. In the case of castings, spots or flaws are usually unseen . . . invisible to normal inspection . . . but present nonetheless and ready to cause trouble.

That's why the highest standards of control and exacting inspection accompany a Sivyer casting through every step of its manufacture. This constant vigilance is your best assurance of flawless, precision steel castings.



S

The sign of a "healthy" casting. The Sivyer Ⓢ is your guarantee of a safe, dependable casting — always look for it.

SIVYER

SPECIALISTS IN HIGH ALLOY AND SPECIFICATION STEEL CASTINGS

SIVYER STEEL CASTING COMPANY • MILWAUKEE Ⓢ CHICAGO Ⓢ MAIN OFFICE: 1675 SO. 43rd ST. • MILWAUKEE, WIS.

Techniques improved with alloy powders

TITANIUM ZIRCONIUM

BASES --→ of many MH alloy powders

Vastly improved techniques in development of alloys are made possible by the use of alloy powders incorporating titanium and zirconium. From these base powders many true alloy powders are available in varying percentages. Among these are chromium, nickel, cobalt etc. Each particle or grain is a true alloy obviating the need of diffusion during the sintering process.

Write today — without obligation — for further technical information.

METAL HYDRIDES INC

12-24 CONGRESS STREET • BEVERLY • MASS.

News Digest

wing to its production facilities which is expected to increase bimetal production facilities over 12%.

Transfer of headquarter and sales offices of its *Pioneer Pump Div.* to 2750 Guardian Bldg., Detroit, and transfer of manufacturing operations to a new plant in Paris, Ky., have been announced by *Detroit Harvester Co.*

Establishment of a Legal and Patent Dept. in General Electric Co.'s Component Products Div. has been announced. All functions pertaining to the division's patents, trade marks, copyrights, and proprietary information are transferred to the new organization. Douglas S. Moore has been named counsel in charge of the department, and Robert G. Irish was named patent counsel.

Swedlow Plastics Co. has acquired the facilities, personnel, methods, techniques and engineering services of the *Sierra Products Co.*, Los Angeles, Calif.

The merger of *Luscombe Airplane Corp.* with and into *Temco Aircraft Corp.* has been completed, and henceforth Luscombe will be known as the *Garland Plant* of Temco.

Formation of a new company, *O'Hara-Rowan Associates,* to serve the plastics industry from the Bassett Bldg., 382 Springfield Ave., Summit, N. J., has been announced. The company was organized to assist in the proper design and development of plastic products, particularly in the packaging field.

Barnes and Reinecke, Inc., Chicago engineering company, specializing in mechanical research and development, was acquired by *Joy Manufacturing Co.* Barnes and Reinecke will continue to operate under its present name and with its present personnel as a subsidiary of Joy.

Vapor Heating Corp. and its manufacturing subsidiary, *Roth Manufacturing Co.,* are building a new two million dollar plant in Niles, Ill. Present plans call for occupancy in January, 1954.

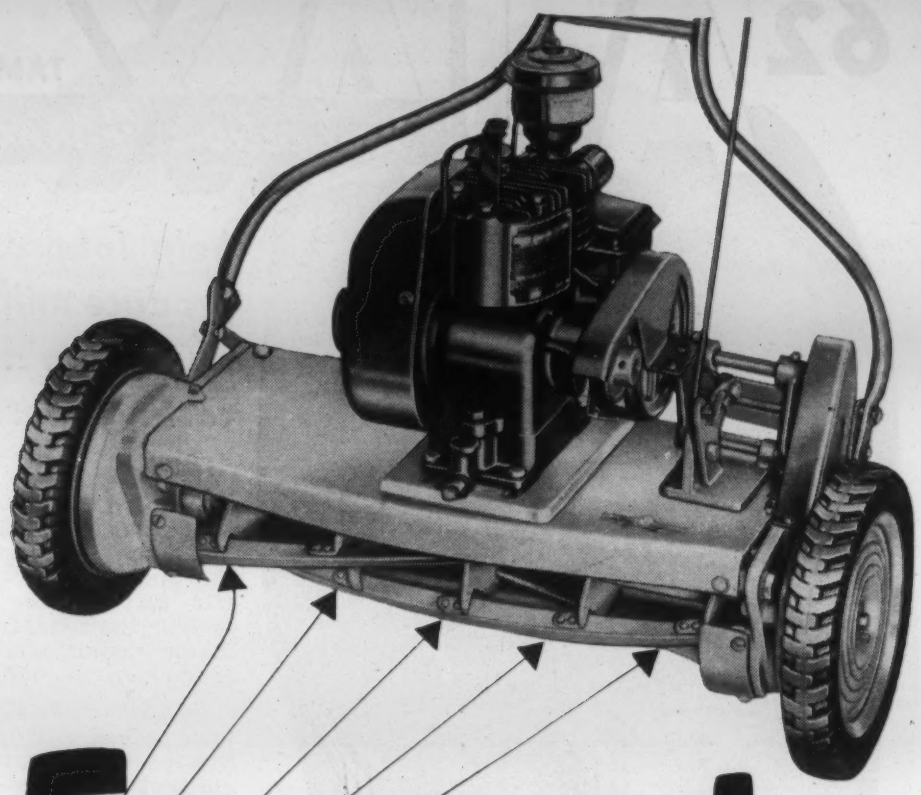
To facilitate its newly instituted plan of market product development, *Vard Inc.* has constructed a new brick and steel engineering building. The entire engineering department has moved into the new structure, located adjoining other company properties on Foothill Blvd., Pasadena.

The new $12,000,000 *Hooker Electrochemical Co.* plant now under construction at Montague, Mich., is scheduled for completion by the year's end.

Follansbee Steel Corp. has taken up new headquarters in the Gateway Center of Pittsburgh's Golden Triangle.

M. W. Kellogg Co. has announced the formation of a special division devoted

HOW A MAKER OF LAWN MOWERS USES Cold-Formed Shapes



Five strong cutter heads help guide the knife blades on this fine power mower. They keep the blades aligned and provide the extra strength required for tough mowing.

These cold-formed shapes also provide something extra for the manufacturer. Because they're supplied to exact dimensions, without any waste material, they are easy to assemble. Relatively free of scale and roughness, they are riveted to the cutter blades quickly and easily, without extensive preparation.

No matter what you manufacture, the chances are good that you could use Bethlehem Cold-Formed Shapes in your product. Applications of these versatile shapes are almost limitless—lately we've made them for use in overhead doors, sign posts, bus bodies, storage racks, and lawn furniture, to name only a few. These and other shapes are made from strip, sheet, or plate steel, from 5 to 24 gage. A rough sketch will enable our engineers to determine whether we can make a practical, economical cold-formed shape for you.

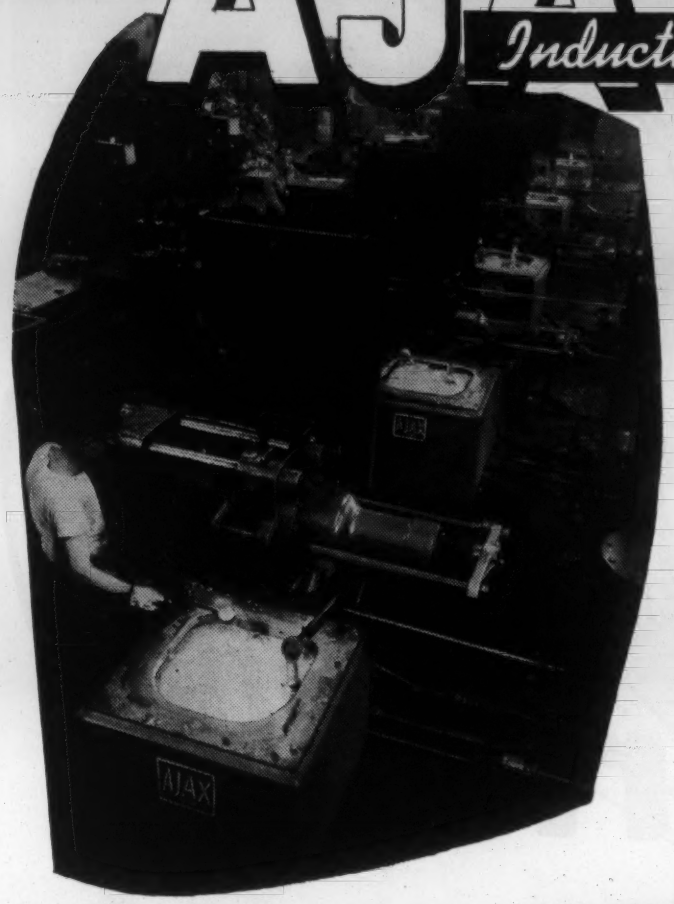
We'll be glad to have our representative visit your shop and discuss the possibilities of using Bethlehem Cold-Formed Shapes in your product. Just phone or write the nearest Bethlehem sales office, or, if you prefer, get in touch with us at Bethlehem, Pa.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

62 AJAX TAMA-WYATT
Induction Furnaces—



help Johnson Motors produce millions of aluminum alloy die castings per year

Johnson Motors, Division of Out-Board & Marine Mfg. Co., Waukegan, Ill., has the largest aluminum die casting plant in the world using exclusively electric furnaces for melting and holding the metal to be processed in die casting machines for the production of outboard motors.

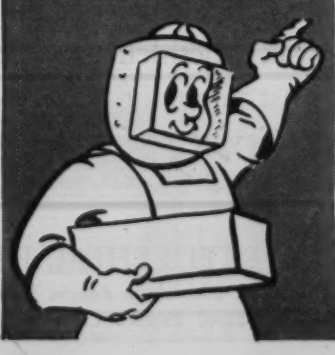
AJAX Induction Furnaces have proved most satisfactory for this concern because they have automatic temperature control, gentle movement of the metal (which prevents segregation), and amazingly low maintenance cost. Some furnaces have been operating for as long as 7 years without renewal of refractory lining.

Photo shows a part of the Aluminum Alloy Die casting Shop at Johnson Motors.

AJAX ENGINEERING CORP., TRENTON 7, N. J.
AJAX TAMA-WYATT INDUCTION MELTING FURNACE
AJAX ELECTRO METALLURGICAL CORP., and Associated Companies
AJAX ELECTROTHERMIC CORP., Ajax Northrup High Frequency Induction Furnaces
AJAX ELECTRIC CO., INC., The Ajax Hultgren Electric Salt Bath Furnace
AJAX ELECTRIC FURNACE CORP., Ajax Wyatt Induction Furnaces for Melting

Wherever You Are "YOU'RE WELDS AHEAD"

with CHAMPION



WELDING ELECTRODES

• Champion Welding Electrodes and Champion Welding Accessories live up to their name for superiority from coast to coast.

Choose Champion and insure complete satisfaction on every application.

Detailed bulletin regarding YOUR specific problems on request. Send for it.

THE CHAMPION RIVET CO.
CLEVELAND, OHIO • East Chicago, Ind.

News Digest

exclusively to the process design of plants for the petrochemical and chemical fields. In addition to the establishment of the new division within its Process Dept., the company will further increase its activities in the petrochemical and chemical fields by additional emphasis in its Research and Development Dept. An industrial scholarship plan, by which salaried employees will have the opportunity of obtaining full tuition grants for undergraduate and graduate study while maintaining their regular base pay, has also been announced by the company. The scholarships, to be offered annually to selected salaried employees of the company and its subsidiaries, consist of one grant for the pursuance of a master's degree and two for a bachelor's degree each year.

Formation of *Integra-Leeds & Northrup Ltd.*, Birmingham, England, has been announced by *Leeds & Northrup* and *S. A. Integra,* Liege, Belgium. The new firm succeeds to the business formerly conducted in Birmingham under the name of *The Integra Co., Ltd.*, which was a branch of the Liege firm.

News of Societies

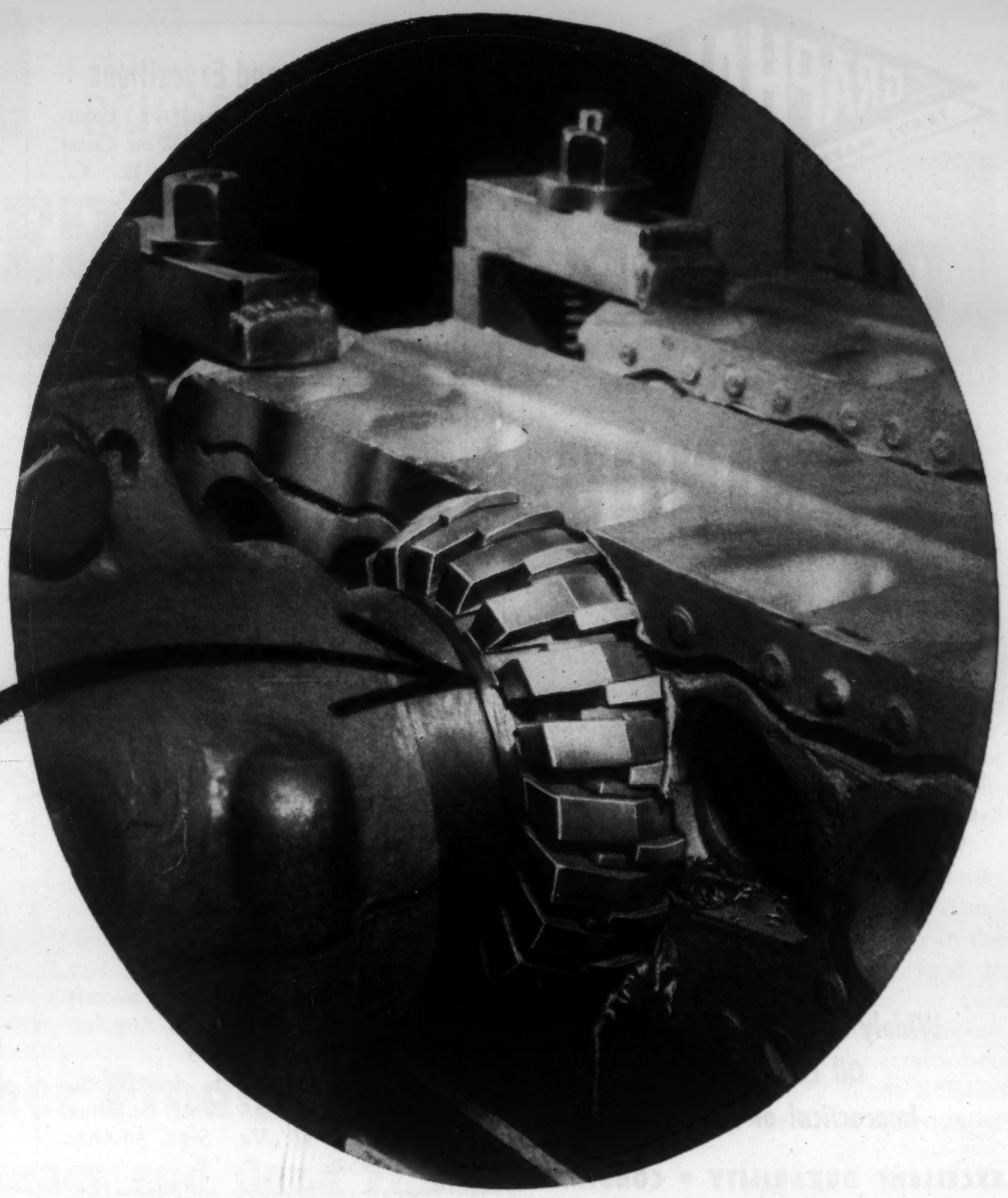
At the annual meeting of the *American Zinc Institute,* Marshall L. Havey, assistant to the president, New Jersey Zinc Co., was elected president. Three vice presidents were also elected to office: Warren H. Leverett, National Zinc Co., Inc.; George W. Potter, Potter-Sims Mines, Inc., and Frank A. Wardlaw, Jr., International Smelting & Refining Co.

James H. Potter has been named professor of mechanical engineering and associate dean at *Stevens Institute of Technology,* where he will serve as head of the mechanical engineering dept.

The Trinks Industrial Heating Award was recently presented to four engineers, all industrial executives. The four honored were: Harry H. Harris, president, General Alloys Co.; Carl I. Hayes, president, C. I. Hayes, Inc.; Carl F. Mayer, president, The Carl Mayer Corp., and J. Spotts McDowell, technical assistant to the president, Harbison-Walker Refractories Co.

Recently elected officers for the *Metal Powder Assn.* for 1953-4 are: Thomas R. Moore, assistant to vice president, General Dyestuff Corp., president; Robert L. Ziegfeld, acting secretary-treasurer; William E. Cairnes, president, Radio Cores, Inc., re-elected chairman of the Electronic Core Div., and vice president; Thomas L. Robinson, president, Powdercraft Corp., chairman of the Fabricators Div., and vice president; Paul E. Weingart, American Metals Co., chairman of the Powder Producers Div. and vice president.

speed up cast iron milling jobs



with

HAYNES STELLITE

Trade-Mark

ALLOY TOOLS

High compressive strength at cutting temperatures . . . good impact strength . . . and extremely low frictional coefficients make HAYNES STELLITE alloys ideal tool materials for cast iron milling jobs.

Two hard grades of HAYNES STELLITE alloy are available for milling cast iron at high speeds. On soft cast iron (less than 185 Brinell), these tools can take light milling cuts at speeds up to 300 surface ft. per min. For heavy milling, speeds up to 250 surface ft. per min. can be used.

Hard cast iron up to 240 Brinell can be milled at speeds as high as 200 surface ft. per minute. Safe chip loads range up to 0.025 in. per tooth.

Tougher grades of HAYNES STELLITE alloy are available for efficient milling of castings that have irregular contours, surface imperfections, or inclusions, or where there are variations in chill depth.

HAYNES STELLITE alloy tools are available as fabricated shell-end mills and as insert milling-cutter blades. The different grades of alloy can be used for a wide variety of milling conditions. If you wish help on your own particular milling problems, write to the nearest Haynes Stellite Company office.

For a copy of the new manual, "HAYNES STELLITE Metal-Cutting Tools," write to our General Offices.

HAYNES TRADE-MARK *alloys*

Haynes Stellite Company.
A Division of
Union Carbide and Carbon Corporation
UCC
General Offices and Works, Kokomo, Indiana
Sales Offices
Chicago — Cleveland — Detroit — Houston
Los Angeles — New York — San Francisco — Tulsa

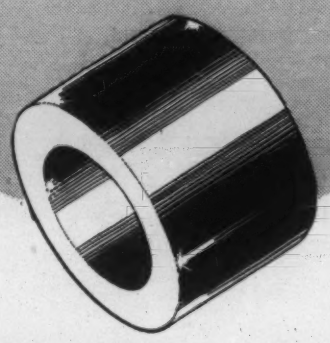
"Haynes" and "Haynes Stellite" are trade-marks of Union Carbide and Carbon Corporation.

GRAPHALLOY
TRADE MARK REG. U. S. PAT. OFF.

OIL-FREE

SELF-LUBRICATING

BUSHINGS



"WORK WHERE OTHERS WON'T"

Widely Used Where Ordinary Oil Lubrication Is Impractical or Impossible.

EXCELLENT DURABILITY • CONSTANT CO-EFFICIENT OF FRICTION • APPLICABLE OVER A WIDE TEMPERATURE RANGE — EVEN WHERE OIL SOLIDIFIES OR CARBONIZES **• OPERATE DRY, OR AT HIGH SPEEDS SUBMERGED IN WATER, GASOLINE AND OTHER LIQUIDS • EXCELLENT FOR CURRENT-CARRYING BEARINGS**

GRAPHALLOY materials are also in wide use for oil-free, self-lubricating piston rings, seal rings, thrust washers, friction discs, pump vanes etc.

OTHER GRAPHALLOY PRODUCTS

BRUSHES

CONTACTS

For applications requiring low electrical noise, low and constant contact drop, high current density and minimum wear. Used for SELSYNS, DYNAMOTORS, SYNCHROS, ROTATING STRAIN GAGE pick-ups and many other applications. Brush Holders and Coin Silver Slip Rings also available.

GRAPHITE METALLIZING CORPORATION

1010 NEPPERHAN AVENUE • YONKERS, NEW YORK

☐ Please send data on Graphalloy Oil-Free BUSHINGS.

☐ Send data on BRUSHES and CONTACTS.

NAME & TITLE

COMPANY

STREET

CITY ZONE STATE

Meetings and Expositions

SOCIETY OF AUTOMOTIVE ENGINEERS, International West Coast meeting. Vancouver, B. C., Canada. Aug. 17-19, 1953.

WESTERN ELECTRONIC SHOW AND CONVENTION. San Francisco. Aug. 19-21, 1953.

ELECTROCHEMICAL SOCIETY, fall meeting. Wrightsville Beach, N. C. Sept. 13-17, 1953.

SOCIETY OF AUTOMOTIVE ENGINEERS, tractor and production forum. Milwaukee. Sept. 14-17, 1953.

PORCELAIN ENAMEL INSTITUTE, annual shop practice forum. Columbus. Sept. 16-18, 1953.

NATIONAL FOUNDRY ASSOCIATION, annual meeting. Sept. 17-18, 1953.

STEEL FOUNDERS' SOCIETY, fall meeting. Hot Springs, Va. Sept. 21-22, 1953.

INSTRUMENT SOCIETY OF AMERICA, national instrument exhibit. Chicago. Sept. 21-25, 1953.

NATIONAL ELECTRONICS CONFERENCE, Chicago. Sept. 28-30, 1953.

SOCIETY OF AUTOMOTIVE ENGINEERS, aeronautic and aircraft engineering display and aircraft production forum. Los Angeles, Sept. 29-Oct. 3, 1953.

PORCELAIN ENAMEL INSTITUTE, annual meeting. White Sulphur Springs, W. Va. Sept. 30-Oct. 2, 1953.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, fall meeting. Rochester, N. Y. Oct. 5-7, 1953.

PRESSED METAL INSTITUTE, annual meeting. Philadelphia. Oct. 7-10, 1953.

GRAY IRON FOUNDERS' SOCIETY, annual meeting. St. Louis. Oct. 8-9, 1953.

NATIONAL CONFERENCE ON INDUSTRIAL HYDRAULICS, annual meeting. Chicago. Oct. 8-9, 1953.

AMERICAN INSTITUTE OF MINING & METALLURGICAL ENGINEERS, Institute of Metals Div., fall meeting. Cleveland. Oct 19-21, 1953.

AMERICAN SOCIETY FOR METALS, annual meeting. Cleveland. Oct. 19-23, 1953.

AMERICAN WELDING SOCIETY, annual meeting. Cleveland. Oct. 19-21, 1953.

SOCIETY FOR NON-DESTRUCTIVE TESTING, annual meeting. Cleveland. Oct. 19-21, 1953.

NATIONAL METAL CONGRESS & EXPOSITION, Cleveland. Oct. 19-23, 1953.

AMERICAN INSTITUTE OF MINING & METALLURGICAL ENGINEERS, Industrial Minerals Div., fall meeting. El Paso. Oct. 28-31. 1953.

FOR MEN WHO USE WIRE MESH BELTS!

HERE'S WHY LEADING MANUFACTURERS SPECIFY "CAMBRIDGE" WIRE MESH CONVEYOR BELTS.

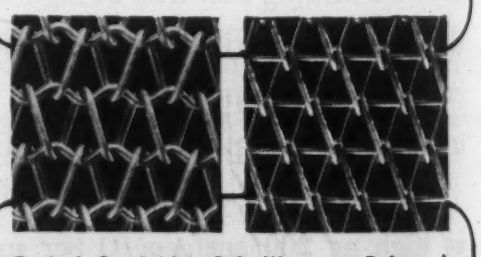
ACCURATE CONSTRUCTION — every step of the construction of your belt is carefully controlled so that the finished belt meets specifications for size, mesh count and mesh opening. Even the welds at the edge of the belt are specially inspected to give you maximum protection at this most vulnerable part.

RANGE OF SPECIFICATIONS — whether you're handling small lightweight parts such as needle bearings or heavy bulky parts such as automotive forgings or castings, there's a Cambridge wire belt specification to meet your needs. Even processing through heat, acids or quenching solutions is a snap when the proper metal or alloy is chosen for fabricating your Cambridge wire mesh conveyor belt.

EXPERIENCED ENGINEERING SERVICE — the combination of trained engineers both in the Cambridge plant and on our Sales Staff is your assurance that the belt recommended for you is the right belt. Cambridge engineers can assist you in any phase of conveyor belt usage . . . conveyor design, plant layout, equipment specifications, etc.

P. S.

IF YOU DON'T USE WIRE MESH BELTS, you'll do well to find out how they can cut costs and boost output by combining product movement with processing in your plant. For information write direct or call in your Cambridge field engineer. See "Belting-Mechanical" in your classified telephone directory for the Cambridge man nearest you.



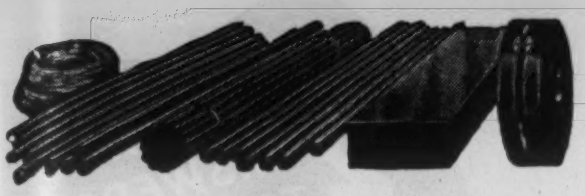
Typical Cambridge Belt Weavers, Balanced and Rod-Reinforced, are widely used for many processes which can be combined with movement. Other Weaves available.

FREE WIRE BELT MANUAL
Gives data on design, installations, construction. Write for your copy now.

The Cambridge Wire Cloth Co.
Dept. A • Cambridge, Md.

WIRE CLOTH | METAL CONVEYOR BELTS | SPECIAL METAL FABRICATIONS

OFFICES IN PRINCIPAL INDUSTRIAL CITIES



BRIDGEPORT BRASS COMPANY

COPPER ALLOY BULLETIN

Bridgeport BRASS CO. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

A variety of automatic screw machine parts which illustrate forming, drilling, threading, knurling, and milling. Courtesy Seymour Brass Turnings Company, Seymour, Connecticut.

Achieving Higher Productivity

Yet Maintaining Accuracy and Good Finish

Higher productivity is the goal of screw machine operators to offset as much as possible rising labor and material costs.

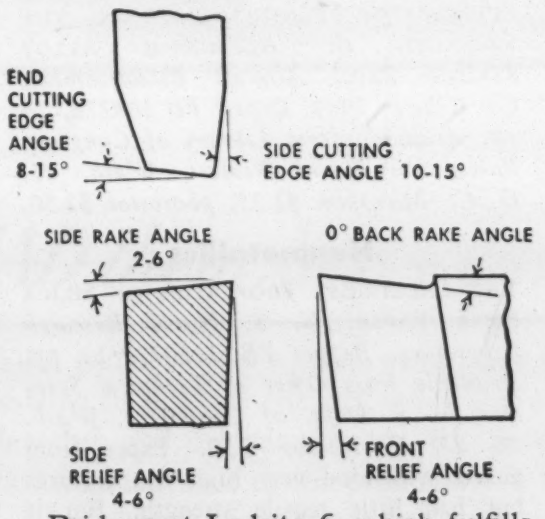
It is recognized that ancient, worn-out equipment in crowded quarters result in high cost, poor working conditions and low productivity. To attain higher productivity, the following factors should be considered:

1. Up-to-date machines — fast and sturdy.
2. Well-designed tools that perform with maximum efficiency and tool life.
3. Fast-cutting brass rod—accurate in dimensions and uniform in quality.
4. Proper coolant-lubricants.
5. Well-arranged layout in a good building.

Turning

On copper alloys the larger portion of forming operations are performed by circular, dovetail or flat tools. Turning and drilling or reaming can be done simultaneously. On exceedingly close tolerance work, drilling can sometimes cause variations in the size of the part. However, in other cases, drilling will tend to support the work.

Tools for cutting metal with a machinability rating between 70 and 100 per cent, require very little rake, as illustrated below.



Bridgeport Ledrite 6, which fulfills at least 90 per cent of requirements, has a 100 per cent machinability rating. It contains 61% copper, 3.4% lead, remainder zinc.

Ledrite 2 Medium Leaded, machinability rating of 90 per cent (65% copper, 1.8% lead, remainder zinc) was developed for excellent machinability plus cold working as required for roll threading, knurling, forming and expanding.

Accuracy

Accuracy is maintained by elimination of mechanical faults, and in many cases its loss can be attributed directly to too much heat generated through friction. Sharp tools of proper hardness are imperative in attempting to hold accurate sizes. However, the removal of chips is an important factor. If the tool is not cutting cleanly, the increased pressure between the work and the tool forces the work away from the tool and at the same time thrusts the carriage back. This condition normally accounts for oversize parts.

Undersized dimensions are generally caused by excessive heat. Vibration in thin, long work pieces or in the tool or machine itself, will lead to variation in dimensions. Lighter cuts will generally reduce this vibration. Rigidity of the brass rod permits better shape and accuracy in the finished part, in other words, better quality control.

Finish

A good finish should be obtained with the first cut if possible, eliminating two operations, viz., roughing and finishing cuts. Finish is affected by practically every condition encountered in machining. Dull tools are the most common cause of poor finish.

Better finishes, in many cases, can be obtained through carefully ground and polished cutting surfaces, the use of higher surface speeds and slower feeds. Minimum rake angles apply to free turning brass rod. However, the condition of the machine—play in the spindle, rigidity in the tool posts and ways—and the type of lubricant affect the finish considerably.

When the front clearance is too small, the burnished or bumpy surface and increased heat through friction instantly reveal the source of trouble. If the finish cut is heavy, high rake and clearance angles cause hogging in and chattering by permitting the tool to vibrate, even though slightly.

Write for Bridgeport's "Technical Handbook" for the physical and mechanical properties of standard rod alloys and other mill products. Please contact the nearest Bridgeport sales office for your metal requirements.

(9958)

WHEN THE JOB CALLS FOR VACUUM

CALL ON

Kinney

SUBSIDIARY OF THE NEW YORK AIR BRAKE CO.

Kinney Manufacturing Co., manufacturers of Vacuum and Liquid Pumps. Representatives throughout the United States and in Foreign Countries.

KINNEY MANUFACTURING CO.
3523 Washington St. • Boston 30, Mass.

Please send Bulletin V-51B describing the Kinney Vacuum Pump line: 9 Single Stage Pumps — 4 Compound Pumps.

Name.....

Company.....

Street.....

City..... State.....

Technical Reports on Materials

Ferrous

EFFECT OF TITANIUM AND VANADIUM ON THE MECHANICAL PROPERTIES AND WELDABILITY OF EXPERIMENTAL LOW-ALLOY HIGH-TENSIL STEEL. *U. S. Naval Research Laboratory, 1948. Report PB 111135, 42 pp. Available from Office of Technical Services, U. S. Dept. of Commerce, Wash. 25, D. C. Mimeo $1.25.* Small variations produced marked effect on transition temperature.

INFLUENCE OF BORON AND NICKEL ON SOME PROPERTIES OF EXPERIMENTAL STEELS CONTAINING 0.3 PERCENT CARBON AND 0.8 PERCENT MANGANESE. *1943. Report PB 108360, 34 pp. Available from Library of Congress, Publication Board Project, Wash. 25, D. C. Microfilm $2.25, photostat $5.00.*

Nonferrous

TITANIUM ALLOY PHASE DIAGRAMS FOR THE SYSTEMS TITANIUM-MANGANESE, TITANIUM-TANTALUM AND TITANIUM-TUNGSTEN. *Battelle Memorial Institute, 1950. Two progress reports: PB 108425, 9 pp., microfilm $1.25, photostat $1.25; PB 108426, 20 pp., microfilm $1.75, photostat $2.50. Available from Library of Congress, Publication Board Project, Wash. 25, D. C.*

TITANIUM-IRON PHASE DIAGRAM. *Univ. of Notre Dame, 1951-2. Two parts: PB 108423, 43 pp., microfilm $2.50; photostat $6.25; PB 108424, 53 pp., microfilm $2.75, photostat $7.50. Available from Library of Congress, Publication Board Project, Wash. 25, D. C.*

EFFECTS OF PRESTRAINING ON THE STRENGTH OF ALUMINUM ALLOY STRUTS. *Royal Aircraft Establishment, Gt. Britain, 1949. Report PB 108774, 13 pp. Available from Library of Congress, Publication Board Project, Wash. 25, D. C. Microfilm $1.75, photostat $2.50.*

Nonmetallics

THE ELECTRICAL PROPERTIES OF SILICA FIBER PAPER. *U. S. Naval Research Laboratory. Report PB 111077, 12 pp. Available from Office of Technical Services, U. S. Dept. of Commerce, Wash. 25, D. C. Mimeo $.50.* Paper from quartz withstood very high temperatures but had little tensile strength. But it can be impregnated to give good mechanical strength and appropriate electrical properties.

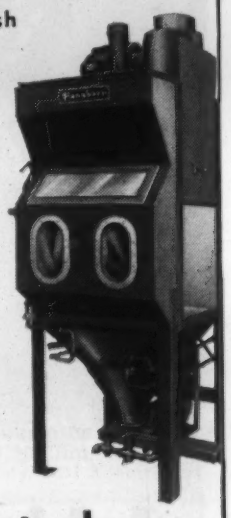
LOW-TEMPERATURE POLYMERIC COMPOSITIONS. *Polaroid Corp., 1950. Report PB 108900, 53 pp. Available from Library of Congress, Publication Board Project, Wash. 25, D. C. Microfilm $2.75, photostat $7.50.* Research directed toward obtaining polymeric compositions which retain their strength and do not undergo brittle failure at temperatures down to —65 F.

(Continued on page 196)

HERE ARE 2 ANSWERS TO YOUR PRODUCTION PROBLEMS!

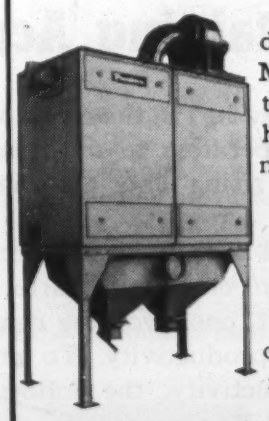
Pangborn cuts costs, saves time

(1) Precision Finishing



Pangborn Hydro-Finish Cabinet—Removes scale and directional grinding lines . . . holds tolerances to .0001" and prepares surfaces for painting or plating. Liquid blast reduces costly hand cleaning and finishing of molds, dies, tools, etc. Models from . . . **$1410** and up.

(2) Dust Control



Pangborn Unit Dust Collector—Traps dust at the source. Machine wear and tear is minimized, housekeeping and maintenance costs reduced. Solves many grinding and polishing nuisances and allows reclamation of valuable material. Models from . . . **$286** and up.

Pangborn Blast Cleaning Machines
Portable model cleans structures, bridges, tanks, quickly and economically . . . $188 and up. Stationary cabinet saves time and money cleaning small metal parts . . . $319 and up.

Write for details on these machines to: PANGBORN CORPORATION, 1700 Pangborn Blvd., Hagerstown, Md.

Look to Pangborn for the latest developments in Blast Cleaning and Dust Control equipment

Pangborn

BLAST CLEANS CHEAPER with the right equipment for every job

...*when you LEAD them*, that's game in the BAG

You have to shoot *ahead* of fast-moving game, if you want to take home something for dinner. Same with business. Now's the time to plan for the day when you can get all the materials you want, with allocations gone, orders maybe not so plentiful, and competition red-hot. ● Allegheny Stainless Steel can work marvels in adding sales advantages to the products you make, or reducing operating costs in the equipment you use. Let our Development Engineers show you how.

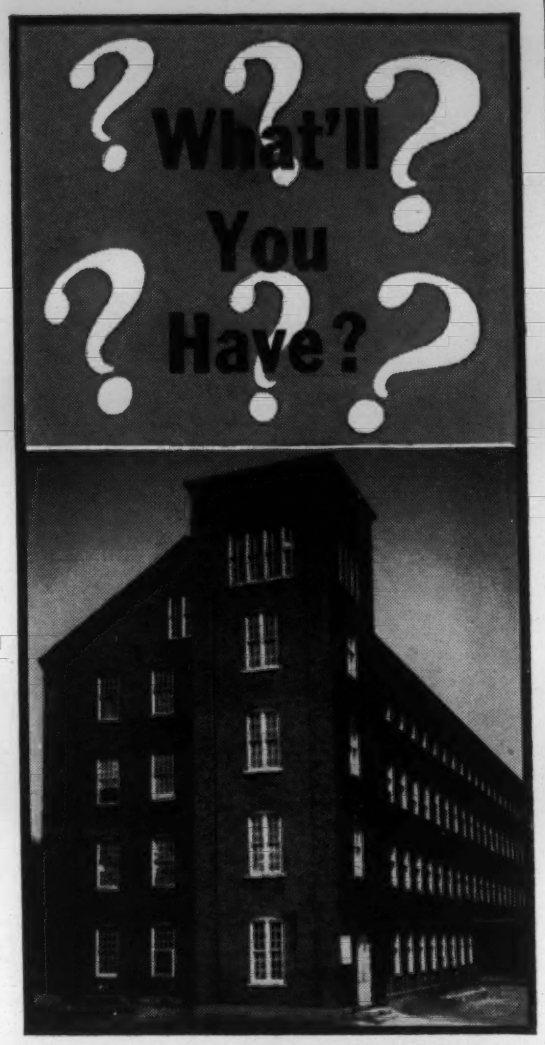
Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.

AL TIME-TESTED STAINLESS STEEL

Warehouse stocks carried by all Ryerson plants

You can make it *BETTER* with

Allegheny Metal



A portion of the facilities of this

PLA-TANK, INC.

(our manufacturing subsidiary)

PLANT, LABORATORY and WORKING FORCE

is now available for

CUSTOM FABRICATION PLASTIC LAMINATES TO YOUR SPECIFICATIONS

by Open-Mold (Hand Lay-up) Methods for items requiring Chemical Resistance, Structural Strength, Light Weight, Electrical Non-Conductivity, Low Resonance. *Finishes superior to porcelain enamel are available.*

Typical of such items are:

Plumbing Fixtures
Building Supplies
Aircraft Components
Boats
Refrigerator Shells
Trays and Pans
Covers and Hoods
Shower Stalls

and other larger shapes in small or moderate quantities. Our engineering department will give a frank opinion on the suitability of any suggested application and quote without obligation.

Regular PLA-TANK® Brand items include Tanks, Pipe, Duct Systems, Fume Hoods and Stacks — the pioneers and leaders in the field!

Address inquiries in confidence to

THE Chemical CORPORATION

67 Waltham Avenue, Springfield 9, Mass.

Technical Reports . . .

continued from page 194

Parts and Forms

SANDWICH CONSTRUCTION AND CORE MATERIALS. PART IV. *W. J. Pullen, R. G. Chapman, S. Pearson and J. K. Oaks, Aeronautical Research Council, Gt. Britain, 1952. Report N-21808, 18 pp. Available on loan from National Advisory Committee for Aeronautics, 1724 F St., Wash. 25, D. C.* Three sections: "Balsolite" Impregnated Paper Cellular Material as an Elastic Stabiliser; Compression Tests on Sandwich Panels with "Balsolite" Cores; Strength Tests of a Typhoon Type Fuselage of "Balsolite" Sandwich Construction.

MOLD DESIGN FOR CASTING STEEL IN SAND. *O.T.S., 1953. Report PB 111100, 14 pp. Available from Office of Technical Services, U. S. Dept. of Commerce, Wash. 25, D. C.*

Coatings

PROTECTIVE VALUE OF SURFACE TREATMENTS FOR MAGNESIUM ALLOYS. *Fred M. Reinhart, National Bureau of Standards, 1952. Report N-22876, 31 pp. Available on loan from National Advisory Committee for Aeronautics, 1724 F St., Wash. 25, D. C.* Eleven different painted surface treatments on three types of magnesium alloys in salt fog, marine atmosphere and tidewater environments.

RELATION BETWEEN ROUGHNESS OF INTERFACE AND ADHERENCE OF PORCELAIN ENAMEL TO STEEL. *J. C. Richmond, D. G. Moore, H. B. Kirkpatrick and W. N. Harrison, National Bureau of Standards, 1953. NACA TN 2934, 29 pp. Available from National Advisory Committee for Aeronautics, 1724 F St., Wash. 25, D. C.* Positive correlation found. In general, better adherence was associated with enamels applied to pickled iron than to sandblasted iron for the same degree of roughness of interface. Although roughness of interface is necessary for good adherence, other factors also are influential.

Joining

ROOM-TEMPERATURE CURING METAL-TO-METAL ADHESIVES. *U. S. Rubber Co., 1951. Report PB 108775, 19 pp. Available from Library of Congress, Publication Board Project, Wash. 25, D. C. Microfilm $1.75, photostat $2.50.* Progress report. Best adhesives were based on ethyllenic-type polymers or on epoxy resins.

INVESTIGATIONS INTO GLUES AND GLUING.. PROGRESS REPORT 71—SEPTEMBER 1952. BEHAVIOUR OF GLUED WOOD PRODUCTS IN LIGHT NAVAL CRAFT. THIRD YEAR'S ANALYSIS. *R. J. Newall and L. S. Doman, Forest Products Research Laboratory, Gt. Britain. Report N-21676, 6 pp. Available on loan from National Advisory Committee for Aeronautics, 1724 F St., Wash. 25, D. C.*

Composition D

WORTHY OF YOUR CONSIDERATION!

may save you thousands of dollars annually!

If you have need of any of the following applications it will pay you to investigate Composition D.

1. **RUST PREVENTATIVE**
2. **SOLVENT**
3. **RANCIDITY RETARDENT**
4. **SOLUBLE OIL ADDITIVE**
5. **FLUX REMOVER**
6. **HEAT TREATING**
7. **HYDROSTATIC TESTING**
8. **TEXTILE FIELD**
9. **MACHINE SHOP OPERATIONS**
10. **WIRE INDUSTRY**

***Send for your* FREE SAMPLE today!**

MITCHELL-BRADFORD CHEMICAL COMPANY

2446A Main St.
STRATFORD, CONN.

Mitchell-Bradford
QUALITY PRODUCTS OF CHEMICAL RESEARCH

RECENT INTERESTING DESIGNS

Aircraft strut part. Wt: 8 ¼ lb.

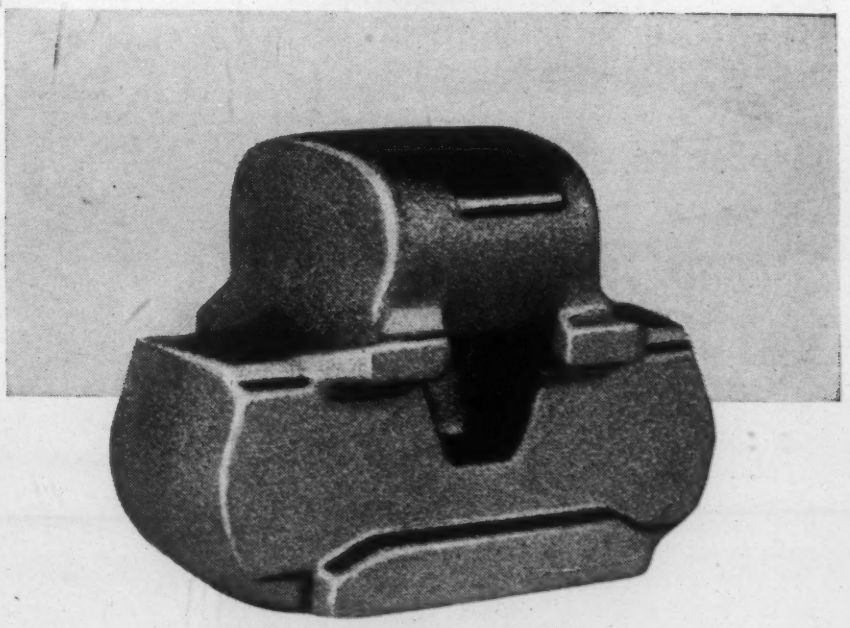
Fulcrum for internal combustion engine. Wt: 4 lb.

from the Bethlehem Drop Forge Shops

Arm for aircraft aileron control. Wt: 6 ½ lb.

Blank for high-speed

gear. Wt: 2 ½ lb.



Link used in coal cutter. Wt: 26 ½ lb.

Every working day of the year the Bethlehem drop forge shops turn out a steady stream of interesting designs; some simple, some complex, but all produced with the same exacting care. A recent group is pictured here, and as you can see, the pieces are meant for use in widely different industrial fields.

These of course are but a few—a tiny fraction—of the huge number of sizes and types that Bethlehem makes. We are equipped for closed-die forgings ranging in weight from several ounces to well over 200 lb—forgings available in carbon or alloy steel, untreated or heat-treated.

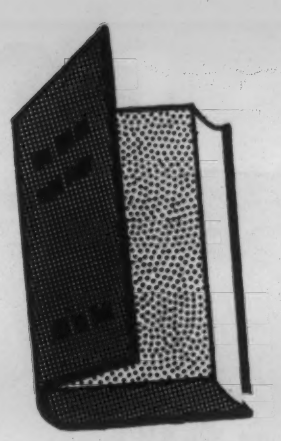
Why not let us see prints of the next design you expect to order? We handle all production details, including the sinking of the dies, in a way to please the most particular buyer.

Bethlehem facilities for the making of closed-die forgings include steam and board drop hammers, 1500 to 8000 lb; mechanical presses to 3000 tons; upsetters 9 in. and smaller.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL



BOOK REVIEWS

Tool Engineering

TOOL ENGINEERS' DATA BOOK. *By Gerhard J. Gruen. Published by Reinhold Publishing Corp., New York, 36, N. Y., 1953. Cloth, 6 by 9 in. 219 pp. Price $5.50.*

Here is a ready reference to all of the tables, formulas, constants and specifications needed by the practicing tool engineer and designer. A special effort has been made to cover all of the latest developments, many of which have never before appeared in print. Complete data on the general properties of special alloys, heat treatment of special alloys and stainless steels, spot identification of metals, alloys and plastics, blank size diameters for shells and a vast amount of other recent information is to be found here. Also included in separate sections are conversion tables, mathematical tables and a glossary of metallurgical terms.

Engineering Materials

INTRODUCTORY ENGINEERING MATERIALS. *By Irving H. Cowdrey and E. L. Bartholomew, Jr. Published by McGraw-Hill Book Co., New York 36, N. Y., 1953. Cloth, 6 by 9 in. 424 pp. Price $6.00.*

This book offers a sound elementary and descriptive treatment of engineering materials. Provided for the reader is a fundamental analysis of the several elements affecting the properties of materials used by various kinds of engineers, designers, and draftsmen. Using a sound basis of cause-and-effect discussion in the explanation of the why of properties in relation to structures and processes, the book provides the student with a complete understanding of the physical picture. This is furthered by an emphasis throughout the work on the correlation between structure and properties. Use is made of photo micrographs rather than equilibrium diagrams in the metallic section, in order to illustrate what really happens by actually showing how internal structures result from certain composition and processes, and in turn determine the mass characteristics. Wherever possible, graphs replace tabulations for additional clarity. Recent advances included here are continuous casting, carbonitriding, ductile cast iron, boron-treated steels, aluminum alloy and sleeve bearings.

Other New Books

ANALYSIS OF ALUMINUM ALLOYS. *By G. H. Osborn and W. Stross. Published by Chemical Publishing Co., Inc., New York 10, N. Y., 1953. 144 pp. Price $3.50.* This is a survey of analytical methods, many of which are new; others are modified versions of known methods, and a few are established standards. Methods range from those requiring modern physicochemical instruments to those which can be carried out with the normal equipment available in the general chemical laboratory. The book lists gravimetric, volumetric, electrolytic, photometric, and polarographic methods for the determination of the most common elements, such as copper, magnesium, nickel, zinc, tin, antimony and chromium. Methods for the determination of less common elements such as beryllium, bismuth, calcium, silver and sodium are also described.

39TH ANNUAL PROCEEDINGS TECHNICAL SESSIONS. *Published by American Electroplaters' Society, Newark 2, N. J., 1953. Cloth, 6 by 9 in. 272 pp. Price $5.00.* Contained in this volume are the proceedings of the 39th Annual Convention of American Electroplaters' Society held in Chicago, June 16-19, 1952. In addition to the business proceedings noted here, the work contains such papers as *Some Experiences in Heavy Rhodium Plating*, Harold J. Wiesner; *An Explanation of Black Nickel Plating*, Earl J. Serfass, Ralph F. Muraca and Walter R. Meyer; *Plastics as Plating Room Engineering Materials*, D. Gardner Foulke; *Vacuum Metallizing Today*, J. Gordon Seiter.

CRERAR METALS ABSTRACTS. *Published by The John Crerar Library, Chicago 1, Ill., 1953. Paper 8½ by 11 in. 56 pp. Price $50 per Twelve Monthly Issues on Subscription Basis.* Increased coverage of Crerar Metals Abstracts to include vanadium swells to more than 170 the number of research and development papers reported in the current issue of this scientific reporting service on critical metals. Monthly reports now cover titanium, zirconium, hafnium, the rare earths, molybdenum, vanadium, and papers of research interest in the field of ferrous alloys. These comprehensive, informative abstracts of research articles and critical reviews enable the research worker to keep abreast of latest developments. A detailed index and cross references aid in quick location of items of special interest.

New concept in photography

ROBOT ★★ Star

For Industry and Science

Motorized For Sequence and Remote Control Photos

Set the Robot-Star just once, and you're all set for as many as 24 (or 48) exposures, made singly or in rapid-fire sequence, as fast as 8 per second! Robot-Star automatically moves film and resets shutter after each exposure. Surpasses human efficiency because of its built-in clock-work motor. Remote control release and other accessories bring new camera applications never before thought possible in science and industry as well as for personal use.

Takes any standard film—color, too. Gets 50% more pictures, with 55 exposures instead of 36 per loading. Choice of Schneider lenses, wide angle to telephoto. For new camera thrills—get Robot-Star—from $217.50.

Now equipped to take 35mm standard cartridges.

Gets the action every time because it's Motorized!

Write for authoritative treatise T—"New Techniques in Photography for Industry and Science"—Sent without charge.

INTERCONTINENTAL MARKETING CORP.
251 Fourth Avenue • New York 10, N. Y.

MANUFACTURERS' LITERATURE

Low Melting Alloys. Cerro de Pasco Corp., 40 Wall St., New York 5, N. Y. Loose-leaf binder and informative engineering literature releases for those interested in keeping abreast of new developments in Cerro alloys. Request direct from Cerro on company letterhead.

Pre-Coated Metal Strip. Coated Coils Corp., 3 pp, ill. Versatile color finishes produced by an exclusive process is illustrated by actual sample of Enamelstrip, the metal coil pre-coated in color. Address inquiries to Mr. Marvin Richfield, Adv. Mgr., 513 W. 30th St., New York, N. Y.

Zinc Die Castings. Dollin Corp., 4 pp, ill. Describes high-speed automatic production of a variety of simple or intricate small zinc die castings. (56)

Magnesium and Aluminum Castings. Eclipse-Pioneer Div. Foundries. "Book of Facts" shows company's facilities for custom-making aluminum and magnesium castings. (57)

Aluminum Alloy. Frontier Bronze Corp. Data on Frontier 40-E aluminum alloy, combining high strength, good shock and corrosion resistance and machinability. (58)

Contact Rivets. Gibson Electric Co., 6 pp, ill, No. C-521. Description and specifications of a complete line of Gibson electrical contact rivets. (59)

Aluminum Extrusions. Harvey Aluminum Div., Harvey Machine Co., 8 pp, ill. Properties, characteristics and applications of a variety of aluminum extrusions produced by this company. (60)

Double-Headed Parts. John Hassall, Inc. Catalog shows numerous double-headed parts, indicating applications and suggesting other applications of double-heading operations. (61)

High Temperature Alloys. Haynes Stellite Div. "Haynes Alloys for High Temperature Service" provides detailed tables and charts on their properties and heat treatment. (62)

Precision Investment Castings. Hitchiner Mfg. Co., Inc., 6 pp, ill. Evaluates precision investment casting methods as to costs, production and properties of parts. (63)

Beryllium-Copper Electronic Components. Instrument Specialties Co., Inc., 8 pp, ill, No. 7-A. Includes specifications of a complete line of micro-processed electronic components of beryllium-copper. (64)

Centrifugal Castings. Janney Cylinder Co., 25 pp, ill. Describes wide variety of finished machined centrifugal castings available. Lists alloys and their properties and types of products. (65)

Bronze Bars. Johnson Bronze Co., 2 pp, ill. Users of Johnson's Universal bronze bars offer many typical applications. (66)

Heat Resistant Titanium Alloy. Kennametal Inc., 6 pp, ill, No. 1052. Lists the many advantages of using Kentanium, a new heat resistant titanium alloy. (67)

Titanium and Its Alloys. Mallory-Sharon Titanium Corp., 16 pp, ill. Current data on the properties of various grades of titanium and titanium alloys. (68)

Metal Hydrides. Metal Hydrides, Inc., 4 pp. Describes metallurgical and chemical hydrides, their use in alloying, hydrogen production, reduction of compounds, etc. (69)

Nonferrous Castings. Monarch Aluminum Mfg. Co., 4 pp, ill. Describes permanent mold castings made by new process to give high dense finish of great durability. (70)

Bronze and Babbitt Metals. National Bearing Div., 2 pp. Price lists of "Tiger Bronze" cored and solid bars and babbitt metals, all for bearing usage. (71)

Precision Casting. Ohio Precision Castings Inc., 12 pp, ill. Numerous examples of industrial applications of this company's brass, bronze, aluminum and beryllium-copper plaster mold castings. (72)

Copper Tubing. Penn Brass & Copper Co., 6 pp, ill. Features of this company's seamless copper tubing. Includes tables of safe internal working pressures of various tubing sizes. (73)

Expanded Metal Meshes. Penn Metal Co., Inc., 24 pp, ill, No. 493 EM. Detailed information on Penmetal Expanded Metal, sheet metal that has been slit and expanded up to 10 times its original width. (74)

Aluminum Castings. The Permold Co., ill. Shows how continuous, scientific control of Permold aluminum casting quality, to specifications, saves time and money. (75)

Spun Shapes. Phoenix Products Co., Metal Spinning Div., 4 pp, ill. Describes Phoenixspun methods for spinning spherical and extra deep-drawn contours. (76)

Aluminum Extrusions. Revere Copper & Brass Inc., 28 pp, ill. Features a simplified easy-to-follow section on standard tolerances of aluminum extruded shapes, presented in table form. (77)

Aluminum and Magnesium Castings. Rolle Mfg. Co., Inc., 16 pp, ill. Complete data on various magnesium and aluminum castings, plus views showing inspection procedures. (78)

Precision Investment Casting. Alexander Saunders & Co., 12 pp, ill. Advantages in comparison with conventional methods of producing precision investment casting, technique, and equipment and supplies needed. (79)

Aluminum and Magnesium Sand Castings. South Gate Aluminum & Magnesium Co., 12 pp, ill. Features the facilities of this company for producing precision aluminum and magnesium sand castings and precision machined parts. (80)

Spun Metal Parts. Spincraft Inc., No. 3. Data book on metal spinning and fabricating gives data on process and help in designing for economical production. (81)

Bourdon-Tube Materials. Superior Tube Co., 4 pp, ill. Reprint discusses properties, shaping, working and joining of three basic classifications of Bourdon-tube materials. (82)

Tungsten Electrodes. Sylvania Electric Products Inc., 2 pp, ill, No. TC-1. Advantages, sizes, surface finishes, tempers and packing and distribution of tungsten electrodes for atomic hydrogen, helium and argon arc welding. (83)

Sintered Metal Parts. U. S. Graphite Co., 40 pp, ill, No. G-53. Attractively presents facilities of this company for producing a wide variety of Gramix high quality low cost sintered metal parts. (84)

Castings and Patterns. Wellman Bronze & Aluminum Co., 16 pp, ill, No. 53. Includes facilities of this company for producing a variety of nonferrous castings and wood or metal patterns. (85)

Self-Lubricating Bearings. Wel-Met Co., 3 pp, No. 104. Lists 133 MPS standard self-lubricating bearing sizes, and gives inside and outside diameter and length dimensions. (86)

Light Metal Forgings. Wyman-Gordon Products Corp., 4 pp, ill. Announces the availability of large-size light alloy forgings, particularly those of magnesium and 75-S aluminum. (87)

Nonmetallic Materials • Parts • Forms

New Basic Lubricants. The Alpha Corp., 8 pp, ill, No. 100. Presents standard industrial grades and compositions of a variety of Molykote Lubricants for use wherever bearing pressures and temperatures are beyond the capacity of conventional lubricants. (89)

Molded Plastics, Hard Rubber. American Hard Rubber Co., 80 pp, ill. Handbook of properties, tolerances and weights, design techniques, machining and finishing methods for this firm's hard rubbers and plastics. (90)

Corrosion Proof Cements. Atlas Mineral Products Co., No. 5-1. Handy charts cover a complete line of resin, sulfur, silicate and asphaltic cements, and shows how to select the correct cement for a specific application. (91)

Gaskets, Packings, Etc. Auburn Mfg. Co., 3 pp, ill. Discusses the various products produced by this company, including gaskets, packings, washers, spacers, seals, shims and bushings. (92)

Rubber Parts. Automotive Rubber Co., Inc. Series of bulletins show use of rubber for insulation or corrosion prevention in industrial equipment. (93)

Piezo-Electric Materials. Brush Electronics Co., 24 pp, ill, No. CD-23001. Complete data on Piezotronics, its many functions, and its broad applications. (94)

Plastics Forms. Cadillac Plastic Co., 12 pp. Size sheets and price lists of Cadillac's plastics materials supplied in sheet, rod and tube. (95)

Ceramic Bodies. Centralab Div., of Globe-Union Inc., 28 pp, ill, No. 720-10M. Comprehensive survey of this firm's ceramic production. Includes description of engineering properties of ceramics, design information, allowable tolerances, and indicates broad scope of ceramic products with data dimensions. (96)

Coated Fabrics. The Connecticut Hard Rubber Co. Uses, chemical, electrical and mechanical properties, and availability of heat resistant silicone rubber coated glass fabrics. (97)

MANUFACTURERS' LITERATURE

Dry Process Molding Materials. Cordo Molding Products Inc. Four bulletins describing Cordopreg dry process methods and their proper use for advantageous results in the reinforced plastics industry. (98)

Commercial Glass. Corning Glass Works, No. B-83. "Properties of Selected Commercial Glasses" gives features of various types of glass and suggests industrial applications. (99)

Plastic. Crane Packing Co., 12 pp, ill, No. T-103. Complete data on Chemlon packings and gaskets fabricated from the new tetrafluorethlyene resin, Teflon. (100)

Industrial Cork Products. Dodge Cork Co., Inc., ill., No. 1h/Do. Includes technical data on cork compositions, natural cork and cork board. (101)

Polystyrenes. Dow Chemical Co., 8 pp. Complete data on the various Styron formulations with regard to properties, methods of molding, and applications. (102)

Synthetic Elastic Compositions. E. I. du Pont de Nemours & Co., Inc., 8 pp, ill, No. A-1427. Presents typical applications and uses of Lucite, Polythene, Nylon, Butacite, Pyralin, Plastacele and Teflon. (103)

Viscose Rayon for Industrial Use. E. I. du Pont de Nemours & Co., Inc., Rayon Div. 9 pp, ill, No. A-319. Gives physical properties, performance and applications of "Cordura", a high tenacity viscose rayon fiber. (104)

Phenolic Molding Compounds and Resins. Durez Plastics & Chemicals, Inc., 4 pp, ill. Includes types, properties and uses of a variety of Durez phenolic molding compounds, industrial resins and coating resins. (105)

Glass-Fiber Reinforced Plastics. The Dynakon Corp., 8 pp, ill. Reprint offers a convenient and practical survey of good practice in glass-fiber reinforced plastic design. (106)

Metal and Plastics Parts. The Electric Auto-Lite Co., Bay Mfg. Div., 16 pp, ill. Shows wide variety of custom-made ornamental and functional metal and plastics parts. (107)

Custom Molded Plastics. Erie Resistor Corp., Plastics Div., 4 pp, ill. Illustrated tour through Erie's new Plastics Div. headquarters showing equipment for manufactured custom molded plastics. (108)

Flexible Tubing. Flexible Tubing Corp., 8 pp, ill, No. 5-4. Applications and performance data on Spiratube flexible tubing for ventilation and materials conveying. (109)

Laminated Thermosetting Plastics. Formica Co., 16 pp, ill, No. 314. Includes technical data on Formica, a laminated thermosetting plastic for electrical, chemical and mechanical applications. (110)

Plastics. General Industries Co., 16 pp, ill. Profusely illustrates the facilities of this company for producing a wide variety of low-cost custom-molded plastics. (111)

Nylon Molded Parts and Gears. John A. English & Co., Nylomatic Div., 1 p, No. 2. Price list of a complete line of nylon molded parts and gears—stock and special stock. (112)

Polyvinyl Chloride Resins. B. F. Goodrich Chemical Co., 16 pp, ill, No. G-8. Bulletin discusses the materials and factors used in calendering, extrusion and injection molding compounds. (113)

Plastic Adhesive. Goodyear Tire & Rubber Co., Inc., 24 pp, ill, No. S-9416. Properties, applications, specifications and data sheets of Pliobond, a quick-setting plastic adhesive that bonds anything to anything. (114)

Thermoplastic Molding Powder. Hercules Powder Co., 15 pp, ill. Applications, specifications and ordering data on cellulose acetate molding powders. Includes detailed properties chart. (115)

Balsa Wood. International Balsa Corp., 20 pp, ill. A factual report on the growth, production, processing and use of Balsa Wood. (116)

Furfuryl Alcohol Resin. Maurice A. Knight Co., 4 pp, ill, No. 6. Properties, uses and applications of Permanite alcohol resins used in the fabrication of corrosion-proof chemical equipment. (117)

Polystyrenes. Koppers Co., Inc., 2 pp, No. C-2-169. Features a table giving all the properties of a complete line of straight and modified polystyrenes. (118)

Mechanical Rubber Goods. Lavelle Rubber Co., 424 W. Wood St., Chicago 22, Ill., 60 pp, ill, No. MS 52. A comprehensive design guide and catalog listing a variety of mechanical rubber goods, and including characteristics and recommended usage. Request direct from Lavelle on company letterhead.

Glass. Libbey-Owens-Ford Glass Co., 8 pp, ill, No. SPD. Describes a variety of types of glass for decorative and functional purposes, giving typical uses, properties and available sizes. (119)

Luminescent Plastics. Luminescent Plastics Corp., 7 pp, ill. Illustrates wide variety of products of luminescent plastic material. (120)

Hydraulic Fluid. Monsanto Chemical Co., Organic Chemicals Div., 4 pp, No. 0-D-602. Properties, test results and description of F-9 nonflammable hydraulic fluid for high-temperature uses. (121)

Carbon Products. Morganite Inc., 8 pp, ill, No. 1f. Specifications of various carbon bearings and bushings. Also, properties of six series of Morganite carbon products. (122)

Mica Insulation. Mycalex Corp. of America, 24 pp, ill, No. VI. Engineering data on Mycalex, a glass-bonded mica insulation for all frequencies. (123)

Molded Rubber Parts. Parker Rubber Products Div., Parker Appliance Co., 4 pp, ill, No. 5201A1. Lists the many advantages of using Parker custom molded rubber parts in a variety of applications. (125)

Nonmetallic Perforated Materials. Pearson Industries, 4 pp, ill. Complete data on Acouperf, a nonmetallic perforated material combining a heretofore unknown degree of sound transparency with novel decorative effects. (126)

Molded Plastics Products. Pro-Phy-Lac-Tic Brush Co., 13 pp, ill. Discusses this company's molding equipment, assembling facilities, and research and testing departments. (127)

Carbon Graphite. Pure Carbon Co., Inc., 32 pp, ill, No. 52. Complete technical data on description, properties, applications and specifications of Purebon carbon graphite. (128)

Extruded and Molded Rubber Parts. Republic Rubber Div., 12 pp, ill. Describes facilities for custom manufacture of molded and extruded rubber products. Describes various products. (129)

Flexible Hose. Resistoflex Corp., 4 pp, ill. Includes chemical and physical properties and typical applications of Resistoflex flexible hose. (130)

Plastics. The Richardson Co., 2782 Lake St., Melrose Park, Ill., 24 pp, ill, No. 836. "Facts About Plastics" gives basic introduction to plastics, their production and uses in industrial and consumer products. Request direct from Richardson on company letterhead.

Fibrous Sheet Materials. Rogers Corp., 19 pp, ill. Data sheets on Rogers' Duroids giving properties, test values and applications of each particular Duroid. (131)

Teflon. Sparta Heat-Treat Co., Plastics Div., 4 pp, ill. Illustrates various Teflon moldings produced by Sparta, and includes a detailed table of typical properties of molded Teflon TF-1. (132)

Plastics. Spaulding Fibre Co., Inc., 8 pp, ill. Presents a detailed list of typical and special applications possible when using Spaulding plastic material. (133)

Cellular Rubber. The Sponge Rubber Products Co., 20 pp, ill. Properties of, specifications for, and test data on this firm's cellular rubber materials. (134)

Plywood. Technical Plywoods. Brief particulars on Plytech, Fybrtech and Carstenite plywoods. (135)

Ceramic Laboratory Ware. The Thermal Syndicate Ltd. Technical descriptions, specifications and prices of Vitreosil ware, said to be superior to porcelain in some uses. (136)

Rubber Products. U. S. Rubber Co., 25 pp, ill, No. M-9012. Detailed description of new research and development laboratory, indicating its place in development of rubber products. (137)

Thermoplastics. Westchester Plastics Inc., 4 pp. Advantages of using this company's services for all types of coloring in molding and extruding of plastics. (138)

Finishes • Cleaning and Finishing

Metallizing Processes. Advanced Vacuum Products Inc., 2 pp, Nos. AV55-H and AV-55-L. Technical data on the AV-55-H metallizing process for producing high temperature vacuum-tight seals, and the AV-55-L metallizing process for producing

MANUFACTURERS' LITERATURE

vacuum-tight ceramic seals for low temperatures. (139)

Chromate Conversion Coatings. Allied Research Products Inc., 4 pp, ill, No. 8. Complete data on the basic characteristics of Iridite chromate conversion coatings, and their functions on various metals. (141)

Metal Plating Facilities. American Nickeloid Co. Brochure shows in detail this company's facilities for plating copper, chromium, nickel and brass on various bases for defense purposes. (142)

Wet Blasting Machine. American Wheelabrator & Equipment Corp., 6 pp, ill, No. 33. Complete data on the Model 64 Liquamatte wet blasting machine for handling individual pieces or loads weighing up to 3500 lb. (143)

Barrel Finishing Compound. Blue Magic Chemical Specialties Co., 2 pp, ill, No. 1. Includes advantages and case histories of Blue Magic No. 1, a cutting and finishing compound for barrel finishing bronze, brass, copper, gold, silver, etc. (144)

Resin-Bonded Laminates for Finishing. The Chemical Corp., 20 pp, ill, No. PD-1R353. Data sheets discuss a variety of tanks, ducts, hoods, stacks and waste pipe for corrosion resistant use. (145)

Degreasers. Detrex Corp., 16 pp, ill. Describes and illustrates a complete line of degreasing machines for every type of solvent cleaning. (146)

Acid Derusting and Descaling Compound. Enthone Inc., 3 pp. Detailed information on Enthone Descaler 2A, a dry, free-flowing acid compound used for removing rust and scale from steels and alloys steels. Prices included. (147)

Organic Coatings. Glidden Co., 8 pp, ill, V. 2, N. 1. Articles discuss a variety of products in home and industry using Glidden's coatings and finishes. Includes chart listing principles to follow to preserve and use finishing materials. (148)

Nickel-Plated Metals. International Nickel Co., Inc., 4 pp, ill, No. EY-93/46. Reprint shows how high corrosion resistance gives nickel-plated metals wide range of uses. (149)

High-Pressure Cleaners. J. P. Mfg. Co., 4 pp, ill. Typical applications of the new 2500 Series Whirlpool high pressure cleaners that degrease, wash, strip and clean in one operation. (150)

Wax Finishes. S. C. Johnson & Son, Inc., 16 pp, ill, No. ADV 322. Brief description of wax finishes for such materials as rubber, metals, building materials, plastics and paper, and methods of applications. (151)

Finishing Equipment. The Murray-Way Corp. Catalog describes full line of this firm's automatic polishing, buffing and grinding equipment. (152)

Cleaning Metal Surfaces. Neilson Chemical Co. Data sheet describes this firm's products meeting government specifications for cleaning, rust removing, etching and protection of metals. (153)

Zinc Dust Paints. New Jersey Zinc Co., 36 pp, ill. Characteristics and uses of zinc dust paints, most adherent paints for galvanized iron and steel zinc. (154)

Metal Cleaner. Niagara Alkali Co. Pamphlet gives properties of Nialk Trichlorethylene, high quality metal-cleaning and degreasing agent. (155)

Cleaning for Plating on Steel. Oakite Products Inc., 27 pp, No. F5867R1. "Four Good Steps Toward Better Electroplating on Steel" describes four steps especially helpful in obtaining superior cleaning of both low and high-carbon steel. (156)

Rust Resistant Coating. Parker Rust Proof Co., 12 pp, ill. Discusses the use of Bonderite, a rust resistant coating, as an aid in cold forming. (157)

Metal Finishing. Pelron Corp., 12 pp, ill. Facilities of this company for handling various specific metal finishing jobs, and some of the products produced. (158)

Corrosion Resistant Coating. Rust Proofing & Metal Finishing Corp., 6 pp, ill. Discusses Endurion, a corrosion resistant finish for iron and steel, obtained by chemical immersion. (159)

Strippable Protective Coating. Seal-Peel Inc., 3 pp, ill. Gives characteristics and advantages of this company's hot dip transparent strippable protective coating. (160)

Metal Cleaning. Solventol Chemical Products Inc., 5 pp, ill. Shows washer designs and exclusive features of Solventol spray washers and their uses in defense jobs. (161)

Zirconium Glazes for Ceramics. The Titanium Alloy Mfg. Div., 30 pp. Description, uses and properties of TAM zirconium glaze opacifiers. (162)

Corrosion Resistant Linings. U. S. Stoneware, Process Equipment Div., 12 pp, ill, No. TL-526. Technical data and typical applications of Tygon corrosion resistant linings. (163)

Heat Treating • Heating

Continuous Quenching Tanks. American Gas Furnace Co., 4 pp, ill, No. 820. Specifications of complete line of continuous automatic quenching tanks. Shows several factory installations. (164)

Ovens and Heaters. Burdett Mfg. Co., 11 pp, ill. Covers sheet metal designing and production facilities of this firm—including ovens, heaters, spray booths and washers. (165)

Furnace Heating Elements. Carborundum Co., Globar Div. Complete data on Globar silicon carbide heating elements, said to be efficient, safe and easy to repair. (166)

Recirculating Furnaces. Despatch Oven Co., 12 pp, ill, No. 81. Shows a variety of Despatch recirculating furnaces in operation on different heat treating applications. (167)

To obtain literature appearing on these pages, please refer to easy-to-use reply card on page 203

Hardening Compound. Doughty Laboratories Inc., 4 pp, ill. Discusses Hard'N'Tuff, a hardening compound that carburizes, nitrides and chromizes steel. (168)

Molten Salt Baths. E. I. du Pont de Nemours & Co. (Inc.), Electrochemicals Dept., 82 pp, ill, No. A-3294. Third edition of a complete guide in the use of molten salt baths for heat treating and case hardening. (169)

Electric Sintering Furnaces. The Electric Furnace Co., 4 pp, ill. Descriptions and uses of nine EF sintering furnaces. (170)

Film Type Heating Elements. Electrofilm Corp., 12 pp, ill. Applications and characteristics of Electrofilm elements for the heating of metal or nonmetal parts. (171)

Electric Heaters, Etc. General Electric Co., 60 pp, ill, No. GEC-1005D. Applications, specifications and prices of a complete line of Calrod electric heaters and heating devices. (172)

Electric Muffle Furnaces. Harper Electric Furnace Corp., No. 346. Features and specifications of this company's line of electric muffle furnaces for such uses as heating and annealing. (173)

Electric Furnaces. Hevi Duty Electric Co., 6 pp, ill, No. HD-153. Specifications and advantages of using Hevi-Duty 2600 F electric furnaces incorporating silicon carbide heating elements. (174)

Radiant Heating. Holcroft & Co., 8 pp, ill. Advantages, characteristics and limitations of radiant tube heating. Details on burner performance and design. (175)

Forced Convection Units. Ipsen Industries, Inc. New design features and specifications of various controlled atmosphere heat treating units designed with 100% forced convection heating for greater efficiency. (176)

Surface Hardening Stainless Steels. Lindberg Steel Treating Co., 24 pp, ill. Gives complete data on the Malcomizing process for surface hardening stainless steels. Seven case histories are included. (177)

Gas Burners. Selas Corp. of America, 4 pp, ill, No. SC-1001. Detailed information on five types of Selas Series PRS Spear Flame gas burners for any localized pointed flame heating requirements. (178)

Air Compressors. The Spencer Turbine Co., 12 pp, ill, No. 126-A. Performance curves, capacity tables and detailed descriptions of Turbo compressors for use in gas or oil fired heat treating equipment. (179)

Heat Treating Accessories. Stanwood Corp., 16 pp, ill, No. 16. Describes variety of heat treating accessories, including baskets, retorts and carburizing boxes. (180)

Liquid Carburizing Salts. Swift Industrial Chemical Co., 4 pp, ill. Complete data on Swift polytherm blended liquid carburizing salts for imparting a hard, wear resistant surface to steel. (181)

Radiant Heaters. Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh 8, Pa., 10 pp, ill. Complete data on the use of Chromalox far-infrared radiant heaters for fusing and embossing cast and calendered materials. Write direct to Wiegand on company letterhead.

MANUFACTURERS' LITERATURE

Welding • Joining

Rubber-to-Metal Bonding. Acushnet Process Co., 8 pp, ill, No. 51-A. Supplement A to the Acushnet rubber data handbook gives more detailed information concerning the rubber-to-metal adhesion process. (182)

Stainless Steel Electrodes. Alloy Rods Co., 20 pp, ill, No. AR53-16. Discusses two basic types of Arcaloy stainless steel electrodes for all stainless steel welding. (183)

Silver Brazing. American Platinum Works, 48 pp, ill. Reference manual on silver brazing discusses low temperature brazing, brazing alloys, design considerations and other topics. (184)

Resistance Welding Alloys and Electrodes. Ampco Metal Inc., 24 pp, ill, No. RW-1a. Physical properties, applications and specifications of a complete line of Ampco-Weld products for resistance welding. (185)

Bonding Resins. Ciba Co., 4 pp, ill. Properties of new group of resins, their applications as adhesives for metals and nonmetallics, moldings and coatings. (186)

Rosin Core Solder. Division Lead Co., 4 pp. Features Divco's X-25 rosin core solder, which provides flux activity at a temperature even before the solder is completely molten. (187)

Rosin Core Solder. Federated Metals Div., American Smelting & Refining Co., 4 pp, ill, No. 158. Advantages of using the new RTS 200 rosin core solder, available in a wide variety of wire sizes, compositions and quantities. (188)

Silver Brazing Alloys. Goldsmith Bros. Smelting and Refining Co., 25 pp, ill. Data sheets on silver brazing alloys include sizes, price, shipment and assortments. Also contains list of typical applications. (189)

Silver Brazing Alloys. Handy & Harman, 24 pp, ill, No. 20. Information on Easy-Flo and Sil-Fos low temperature silver brazing alloys, and valuable data on brazing methods. (190)

Threaded Inserts. Heli-Coil Corp., 15 pp, ill, No. 650-R. Description, advantages and specifications of Heli-Coil threaded inserts for insertion into tapped holes to protect threads, reduce wear and expense. (191)

Stud Welding. KSM Products Inc., 27 pp, ill. Booklet explains correct use of stud welding equipment, and outlines steps and procedures to be followed. (192)

Induction Heating for Brazing. Lepel High Frequency Laboratories Inc., 8 pp, ill. Details on induction heating units for accelerated brazing of parts. (193)

Inert-Gas-Welding Torches. Linde Air Products Co., No. 7979. Details and specifications of the newest Heliarc torches for inert gas shielded arc welding. (194)

Silver Brazing Preforms. Lucas-Milhaupt Engineering Co., 10 pp, ill. Features an interesting article on the advantages of using silver alloy preforms. Includes detailed specifications. (195)

Hard Surfacing Electrodes. The McKay Co., 4 pp, ill. Typical applications and specifications of McKay Hardalloy 58 low hydrogen hard surfacing electrodes for severe impact and resistance to abrasion. (196)

Electrodes and Holders. P. R. Mallory & Co., Inc., Welding Div., 2 pp, ill, No. 8-11. Advantages, design and application of 8-deg (4 deg per side) ⅝-dia spot welding electrodes and holders. (197)

Tubular Furnaces. Marshall Products Co., 4 pp, ill. Discusses both the creep test and tensile test models of Marshall tubular furnaces, as well as control panels and radial brackets. Includes specifications. (198)

Adhesives. Merchants Chemicals Co., 4 pp. Lists various Dyna Bond adhesives, their characteristics and industrial uses. (199)

Precious Metal Solders. The J. M. Ney Co., 1 p. Melting ranges, colors and identification numbers of this company's gold and platinum solders for electronic tubes. (200)

Fasteners. Prestole Corp., 1345 Miami St., Toledo, Ohio, 8 pp, ill, No. D-1952. Technical data on the Prestolizing methods of fastening sheet metal parts and products. Write direct to Prestole on company letterhead.

Screws. Russell, Burdsall & Ward Bolt & Nut Co., 8 pp, ill. Presents principle of fastening, advantages and specifications of a complete line of Spin-Lock screws available in hex, pan, truss or flat heads. (201)

New Fastener. Shakeproof Inc., 16 pp, ill, No. AS-39. Describes Keps preassembled nuts and lockwashers claimed to eliminate lockwasher handling. (202)

Fastening Specialties. Southco Div., South Chester Corp., 22 pp, ill, No. B-2. Information on industrial fasteners for metal-to-metal and metal-to-wood applications, including installation procedure and dimensional data. (203)

Stainless Steel Fasteners. Star Stainless Screw Co. Lists Star's stainless and special screw machine products available. (204)

Welding Procedure. Stoody Co. Folder describes welding procedure for repairing metal parts such as top carrier rolls for tractor treads. (205)

Welding Steel Castings. Tempil Corp., 11 W. 25th St., New York, N. Y., 40 pp, ill. Technical data book on the recommended practice for the welding of steel castings, prepared and published by the Steel Founders' Society of America. Request direct from Tempil on company letterhead.

Nut Retainers. Tinnerman Products Inc., 8 pp, ill, No. 245-3. Specifications and descriptions of Speed Grip nut retainers offering a sure method of keeping nuts secure. (206)

Welding Machines. Westinghouse Electric Corp., 17 pp, ill, No. B-5622. Describes three basic a.c. welding machines and their accessories produced by Westinghouse. Specifications included. (207)

To obtain literature appearing on these pages, please refer to easy-to-use reply card on page 203

Forming • Casting • Molding Machining

Die Casting Machine. A. B. C. Die Casting Machine Co., 4 pp, ill. Complete details and specifications of the 1-lb zinc ABC die casting machine. (208)

Preform Press. Baldwin - Lima - Hamilton Corp., 4 pp. Physical data, press description, operation of Model #60 preform press for high bulk factor materials. (209)

Coated Abrasive Tools. Behr-Manning Div. of Norton Co., 6 pp, ill. Folder includes various problems encountered and explains how they were solved with mechanical polishing coated abrasive tools. (210)

Specimen-Cut-Off Machines. Buehler Ltd. Describes complete line of metallurgical specimen cut-off machines available for samples from ½ to 3 in. in dia. (211)

Grinding. Carborundum Co., Form A-1204. New revised Series of 32 bulletins, 8 entirely new, of this company's grinding tools. (212)

Machining Equipment. The Cincinnati Milling Machine Co., 48 pp, ill, No. M-1712. Features and specifications of this company's automatic flame hardening machines, grinding machines and milling machines. (213)

Moly-Sulfide Lubricant. Climax Molybdenum Co., 40 pp. Detailed tables of applications of moly-sulfide lubricant in the manufacturing plant, the job shop and in the field, indicating form used, and results of applications. (214)

Coiling Machine. Driver-Harris Co., No. C-52. Information on new coiling machine said to eliminate coil irregularity due to work-hardened areas produced during coil formation. (215)

Chamfering Electrode. Eutectic Welding Alloys Corp., 25 pp, ill. Describes ChamferTrode, new rod for gouging, chamfering and milling operations on all metals and alloys without oxygen or special equipment. (216)

Tungsten Carbide Compacting Tools. National Carbide Die Co., 4 pp, ill. Discusses various tungsten carbide compacting tools as they are applied to powdered metallurgy. (217)

Drilling Machine. Wales-Strippit Corp., 8 pp, ill, No. DM. Describes features, setting up, operation and accessories of Wales drilling machine, designed for precision location of holes. (218)

Aluminum Extrusion Presses. Watson-Stillman, ill, No. 340-A. Describes this company's light metal extrusion presses of 500- to 5000-ton capacities, their features and advantages. (219)

Adjustable Perforating Dies. S. B. Whistler & Sons Inc. Catalog describes this company's line of adjustable perforating dies for punching holes in sheet metals. Includes prices and applications. (220)

Tube Mills. The Yoder Co., 65 pp, ill. Pros and cons of operating a tube mill, plus detailed information on the process. Also, technical data on standard and other equipment. (221)

MANUFACTURERS' LITERATURE

Inspection • Testing • Control

Laboratory Chemicals. Allied Chemical & Dye Corp., General Chemical Div., 264 pp, ill. Catalog of laboratory reagents and chemicals describes their properties, specifications, storage, packaging and other data. (221A)

Test Chambers. American Research Co., 4 pp, ill. Describes the basic environmental test chambers produced by this company for testing under a variety of conditions. (222)

Contour Measuring Projector. Bausch & Lomb Optical Co., No. D-27. Specifications and features of contour measuring projector claimed to enable very accurate measurements of parts. (223)

Magnifying Contour Projector. Eastman Kodak Co., 8 pp, ill, No. F1-23. Operating principle, applications, features, specifications and accessories of this firm's contour projector. (224)

Pyrometers. General Electric Co., Apparatus Dept., 8 pp, ill, No. GEA-5534. Sensitivity, rugged construction and easy replacement are among features stressed for the G-E pyrometer. (225)

Metallurgical Laboratory Equipment. Harshaw Chemical Co., Harshaw Scientific Div., 12 pp, ill, No. D2637. Catalog describes and gives specifications of this company's available metallurgical laboratory equipment. (226)

Dew Point Indicator. Illinois Testing Laboratories. Describes Alnor Dewpointer for checking, simply and accurately, the dew point of gases generated for heat treating. (227)

Fatigue Testing Machines. Krouse Testing Machine Co., 10 pp, ill, No. 46-B. Describes company's plate and sheet fatigue testing machines, including specifications and testing data. (228)

Inspection Tool. Magnaflux Corp., 4 pp, ill. How and where to use Spotcheck, an improved dye penetrant inspection method for locating defects open to the surface in metals, ceramics, plastics and other nonporous solid materials. (229)

Laboratory Filters. Micro Metallic Corp., 6 pp, ill. Features available forms of a variety of stainless steel laboratory filters with porous stainless steel filter elements. (230)

Profilometer Chart. Micrometrical Mfg. Co. Wall chart lists working range of Profilometer equipment for measuring surface roughness in millionths of an inch. (231)

Impact Testing Machines. National Forge & Ordnance Co., Testing Machine Div., 4 pp, ill, No. 523. Discusses a new low capacity impact tester for plastics, ceramics and light metals. Includes specifications. (232)

Spectrographs. National Spectrographic Laboratories Inc., 4 pp, ill, No. 300. Description, operating principle and control features of spectrograph units for both quantitative and qualitative analysis. (233)

X-Ray Spectrometry. North American Philips Co., Inc., 4 pp, ill, No. S-201. Reprint explains the use of x-ray diffraction and x-ray spectrometry in handling difficult laboratory and production line tasks. (234)

Radiation Pyrometer. The Pyrometer Instrument Co., No. 100. Features and principle of Pyromradiation pyrometer for obtaining spot temperatures in furnaces, kilns, forgings and fire boxes. (235)

Impact Testing Machine. Riehle Testing Machines Div., American Machine & Metals Inc., 6 pp, ill, No. RM-8-52. Booklet gives operating features and specifications of the Riehle Model PI-2 impact testing machine. Also illustrates other Riehle testing machines. (236)

Tensile Testing Machines. Scott Testers Inc., 6 pp, ill, No. 50. Shows wide assortment of testing machines for testing tensile strength of materials such as rubber, paper, wire and thread. (237)

Testing Machines. Steel City Testing Machines Inc., 4 pp, ill, No. G-252. Describes and illustrates a complete line of Brinell hardness testing machines. (238)

Pyrometer Wire Color Codes. Thermo Electric Co., Inc. Handy chart gives pyrometer color codes, calibration symbols and parts meeting ISA, military and aeronautical specifications. (239)

Package Testing. U. S. Testing Co., Inc., 8 pp, ill. Describes methods for testing packages designed for products up to 1000 lb for vibration and impact. Includes prices. (240)

General

Lettering Machine. Ralph C. Coxhead Corp., 4 pp, ill. Lists the many advantages of using the Vari-Typer lettering machine in the drafting room. (241)

High Vacuum Applications. Distillation Products Industries, 16 pp, ill, No. CEC-1801B. Applications, methods, features, operation and performance of the model 24-101A leak detector in accurately detecting and locating leaks in vacuum or pressure equipment. (242)

Vacuum Pump. Kinney Mfg. Co., No. V51-A. Features, specifications and price information on the CVM3153 Midget Vacuum Pump. (243)

Chain and Belt Conveyors. Michigan Steel Casting Co., 6 pp, ill, No. 1-B. Shows Misco rivetless chain conveyors and Woodman belt conveyors for high temperatures. (244)

Radiation Detection and Counting Instruments. Nuclear Measurements Corp., 24 pp, ill. Presents a complete line of radiation detection and counting instruments, featuring proportional counters and proportional counter converters. (245)

Materials Controls. Remington Rand Inc., No. KD 367. Booklet describes Kardex system for keeping visible materials and parts inventories coordinated with production. (246)

Industrial Chilling Equipment. Sub-Zero Products Mfg. Div., Deep Freeze Distributing Corp., 8 pp, ill. Specifications and uses of industrial chilling machines for shrinking, testing and treating of metals. (247)

Metal Processing. Arthur Tickle Engineering Works, Inc., 16 pp, ill. Profusely illustrates the facilities of this company for forging and plate fabricating, metal spraying, and Alumibonding and aluminum casting. (248)

What do you know about the

Moly-sulfide
A LITTLE DOES A LOT

LUBRICANT?

You may have heard about a highly successful solid-film lubricant which is giving remarkable results in the shop and in the field.

In one 40-page booklet we have collected 154 detailed case-histories describing how difficult lubrication problems have been overcome by molybdenum sulfide. If you wish to be up to date about this solid-film lubricant, write for a free copy now.

THE LUBRICANT OF MANY USES

Moly-sulfide
A LITTLE DOES A LOT

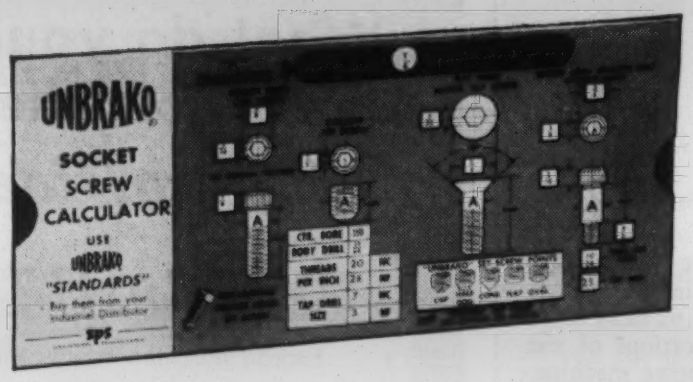
Climax Molybdenum Company
500 Fifth Avenue
New York City • 36 • N • Y •

SEND FOR THIS FREE BOOKLET TODAY

Name.....
Position.....
Company.....
Address.....

MOLY

MM-7 MS-3



Our New UNBRAKO Screw Calculator
YOURS FOR THE ASKING

This handy pocket-sized slide-rule type socket screw calculator gives diameters, lengths, socket dimensions, threads and drill sizes—in fact, everything you want to know when using UNBRAKO socket screw products.

And it's free. Ask your UNBRAKO distributor or write SPS, Jenkintown 60, Pa.

UNBRAKO®

Standard UNBRAKOS *are sold by leading industrial distributors everywhere.*

SOCKET SCREW DIVISION

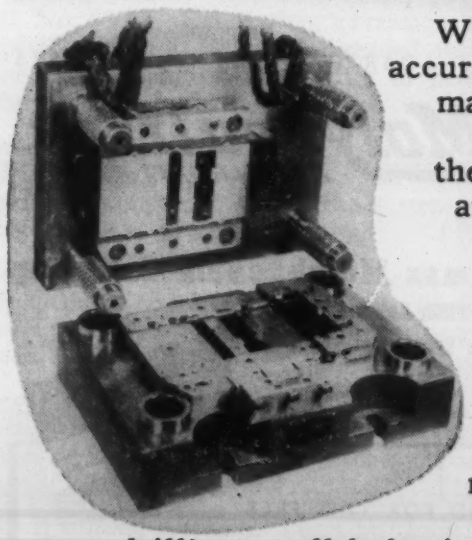
Our Fiftieth Year : A START FOR THE FUTURE

SPS

JENKINTOWN PENNSYLVANIA

Self-Locking Set Screws | **Flat Head Cap Screws** | **Shoulder Screws** | **Knurled Head Cap Screws** | **Dowel Pins** | **Button Head Socket Screws**

CEMENTED CARBIDE THREADED, TAPPED, BROACHED, PRECISION MACHINED!



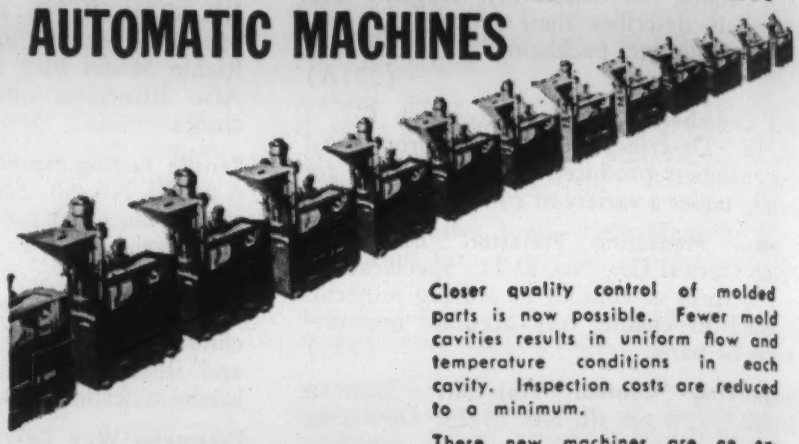
With amazing speed and accuracy, the hardest man-made metals can now be machined. Some of the work now being done at Arc Machining, Inc. includes machining of carbide dies; finish machining after final heat treatment where distortion presents a problem; corrective machining of hardened parts; die revisions; drilling small holes in stainless steel tubing, etc. without burrs. These and many more applications of "arc machining" are saving specification and process engineers thousands of dollars each day. Send us your problem today.

ARC MACHINING, INC.
722 N. Rochester Rd. • Clawson, Michigan

Pyro Plastics
Starting Point for a Better Product

VOLUME 1 NUMBER 4

LOWER MOLDING COSTS WITH NEW AUTOMATIC MACHINES



PYRO's Engineers and Technicians have developed new molding equipment—which reduces production costs for small parts. These machines eliminate the "human element" by operating fully automatically and are ideally adapted to both long and short run production. Such high speed operation eliminates the need for large, expensive multi-cavity molds. Thus, mold costs are lower too.

Closer quality control of molded parts is now possible. Fewer mold cavities results in uniform flow and temperature conditions in each cavity. Inspection costs are reduced to a minimum.

These new machines are an exclusive development by Pyro. A large battery stands ready to serve you.

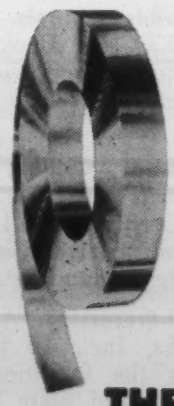
Investigate now! Send your part designs and complete information to PYRO for prompt, money-saving quotations. Complete injection molding services under one roof: Product Design and Development, Engineering and Tooling, Production and Assembling. Why pay more than necessary? It will pay you to check with PYRO.

Pyro PLASTICS CORPORATION
PYRO PARK, UNION, NEW JERSEY

ENAMELSTRIP

STEEL · ALUMINUM · BRASS · PRE-FINISHED COLOR COIL

assures a
perfect finish
before fabricating



You can easily cut production time and cost with Enamelstrip, the continuous-feed, pre-colored metal coil. Leading manufacturers of metal products are using it with outstanding results in a wide variety of items. Enamelstrip's exclusive flexible finish withstands the stresses of drawing, bending and forming without cracking or peeling. Many companies have entirely eliminated their finishing departments! Any metal in any finish will be coated and slit to your own specifications.

Write TODAY for detailed color bulletin.

THE COATED COIL CORPORATION

513 West 30th Street, New York 1 • LOngacre 5-3161

Lebanon Steel Foundry 132
Agency—Foltz-Wessinger, Inc.

Lee Rubber & Tire Corp. 116

Libbey-Owens-Ford Glass Co., Fiber-Glass Div. 19
Agency—Brooke, Smith, French & Dorrance, Inc.

Lindberg Engineering Co. 135
Agency—Saunders, Shrout & Associates, Inc.

Litemetal Diecast, Inc. 216
Agency—L. J. DuMahaut Advertising Agency

Lucas-Milhaupt Engineering Co. 213
Agency—Thomas J. Hubert Advertising Counsel

Maas & Waldstein Co. 169
Agency—Franklin Fader Co.

Mahon, R. C., Co. .....2nd Cover
Agency—Anderson, Inc.

Mallory, P. R., & Co., Inc. 24
Agency—Aitkin-Kynett Co.

McDanel Refractory Porcelain Co. 134
Agency—Edward M. Power Co., Inc.

Metal & Thermit Corp. 53
Agency—Raf Advertising, Inc.

Metal Hydrides, Inc. 188
Agency—Tippett, Jackson & Nolan, Inc.

Michigan Powdered Metal Products Co., Inc. 136
Agency—Charles M. Gray & Associates

Michigan Steel Casting Co. 178
Agency—L. Charles Lussier, Inc.

Milford Rivet & Machine Co. 172
Agency—E. J. Lush, Inc.

Minnesota Mining & Mfg. Co. 52
Agency—MacManus, John & Adams, Inc.

Mitchell-Bradford Chemical Co. 196
Agency—Langeler Advertising Agency, Inc.

Monsanto Chemical Co., Plastics Div. 57
Agency—Gardner Advertising Co.

Moraine Products Div. 145
Agency—Campbell-Ewald Co.

Mueller Brass Co. 147
Agency—Price, Hedrick & Tanner, Inc.

Murray-Way Corp. 202
Agency—F. B. Hubert Advertising Counsel

National Research Corp. 158
Agency—Sutherland-Abbott

National-Standard Co. 163
Agency—Griswold-Eshleman Co.

National Tube Div. 55
Agency—Batten, Barton, Durstine & Osborn, Inc.

Naugatuck Chemical Div. 139
Agency—Fletcher D. Richards, Inc.

New Jersey Zinc Co. 10

Ney, J. M., Co. 184
Agency—Edward W. Robotham & Co.

Niagara Alkali Co. 26
Agency—Hazard Advertising Co.

Northwest Chemical Co., Inc. 165
Agency—F. B. Hubert Advertising Counsel

Norton Co. 159
Agency—James Thomas Chirurg Co.

Ohio Precision Castings, Inc. 214
Agency—Hugo Wagenseil & Associates

Oiljak Manufacturing Co., Inc. 216
Agency—Kenyon-Baker Co., Inc.

Pangborn Corp. 28, 194
Agency—Vansant, Dugdale & Co., Inc.

Penn Metal Co., Inc. 170
Agency—Gassaway Advertising Agency

Phoenix Products Co. 174
Agency—Barnes Advertising Agency, Inc.

Pyro Plastics Corp. 210
Agency—Adolf F. Gottesmann Advertising Agency

Reinhold Publishing Corp. 217, 219

Republic Rubber Div. 116
Agency—Meek & Thomas, Inc.

Republic Steel Corp. 45, 123
Agency—Meldrum & Fewsmith, Inc.

Revere Copper and Brass, Inc. 9
Agency—St. Georges & Keyes, Inc.

Reynolds Metals Co. 42, 43
Agency—Price, Robinson & Frank, Inc.

Riverside Metal Co. 47
Agency—Robert S. Kampmann Jr., Advertising

Relock, Inc. 133
Agency—Edward W. Robotham & Co.

Roth Rubber Co. 118
Agency—Christopher, Williams & Bridges

Rubatex Div. 22
Agency—Houck & Co., Inc.

Ryerson, Joseph T., & Son, Inc. 58
Agency—Aubrey, Finlay, Marley & Hodgson, Inc.

Saunders, Alexander, & Co. 214
Agency—Charles MacKenzie Advertising

Sinko Manufacturing & Tool Co. 212
Agency—Allen J. Siegel Advertising

Sivyer Steel Casting Co. 187
Agency—Hoffman & York, Inc.

Sponge Rubber Products Co. 56
Agency—Conklin Mann & Son

Stalwart Rubber Co. 185
Agency—Penn & Hamaker, Inc.

Standard Pressed Steel Co. 210, 214
Agency—Gray & Rogers

Standard Steel Works Div. 181
Agency—Ketchum, MacLeod & Grove, Inc.

Standard Tube Co. 122
Agency—Zimmer, Keller & Calvert, Inc.

Stanwood Corp. 134
Agency—Tri-State Advertising Co., Inc.

Superior Steel Corp. 51
Agency—Walker & Downing

Surface Combustion Corp., Heat Treat Div. 115
Agency—Odiorne Industrial Advertising

Taylor Fibre Co. 141
Agency—Aitkin-Kynett Co.

Technic, Inc. 200
Agency—George T. Metcalf Co.

Thermo Electric Co., Inc. 177
Agency—Fred Lange Associates, Inc.

Thompson Products, Inc. 121
Agency—Meldrum & Fewsmith, Inc.

Timken Roller Bearing Co., Steel & Tube Division .....Back Cover
Agency—Batten, Barton, Durstine & Osborn, Inc.

Trent Tube Co. 155
Agency—G. M. Basford Co.

Tennessee Coal & Iron Div. ..101, 102, 103, 104
Agency—Batten, Barton, Durstine & Osborn, Inc.

Unitcast Corp. 160
Agency—Beeson-Reichert, Inc.

Union Carbide & Carbon Corp. 191

United States Graphite Co. 23
Agency—Price, Hedrick & Tanner, Inc.

United States Rubber Co. 106, 139
Agency—Fletcher D. Richards, Inc.

United States Steel Corp. 55, 101, 102, 103, 104
Agency—Batten, Barton, Durstine & Osborn, Inc.

United States Steel Export Co. 55, 101, 102, 103, 104
Agency—Batten, Barton, Durstine & Osborn, Inc.

United States Steel Supply Div. 101, 102, 103, 104
Agency—Batten, Barton, Durstine & Osborn, Inc.

Vanadium Corporation of America 144
Agency—Hazard Advertising Co.

Ward Leonard Electric Co. 130
Agency—James Thomas Chirurg Co.

Waukesha Foundry Co. 199
Agency—Morrison-Greene-Seymour, Inc.

Werner, R. D., Co., Inc. 140
Agency—Wilson, Haight & Welch, Inc.

Western Felt Works 215
Agency—Critchfield & Co.

Westinghouse Electric Corp. 156
Agency—Fuller & Smith & Ross, Inc.

Wickwire Spencer Steel Div. 175
Agency—Doyle, Kitchen & McCormick, Inc.

Wilson Mechanical Instrument Div. 157
Agency—Reincke, Meyer & Finn, Inc.

Youngstown Sheet and Tube Co. 20
Agency—Griswold-Eshleman Co.

ATTENTION:

- MATERIALS ENGINEERS
- DESIGNERS
- ENGINEERS

Reprints Available

Complete your file of manuals covering materials, fabricated parts and processes. MATERIALS & METHODS has published 60 of these outstanding manuals during the last five years. The supply of many has been exhausted, but the following subjects are available:

61 Extruded Metal Shapes & Their Uses
62 Ceramics for Engineering Applications
63 Heat Resistant Castings
64 Mechanical Finishing of Metals—for Decorative Purposes
65 Welding Electrodes and Rods—for Ferrous & Nonferrous Metals
67 Nondestructive Testing of Engineering Materials and Parts
68 Glass as an Engineering Material
69 Cleaning and Finishing Stainless Steels
70 Compression Molded Plastic Parts
71 Wrought Aluminum Alloys
72 How to Overcome Materials Shortages in Product Design and Manufacture
73 Die Castings
74 Wrought Phosphor Bronzes
75 Salt Baths for Metal Treating
76 Cold-Headed Parts
77 Titanium, Zirconium, Molybdenum, Etc. as Engineering Materials
79 Plastics as Alternate Materials
80 How to Select Brazing & Soldering Materials
81 Carbon & Graphite Materials & Parts
82 Titanium and its Alloys
83 Electroplated Coatings on the Light Metals
84 Cold Forming Stainless Steel Parts
85 Tool Steels
86 Carbon and Low Alloy Steel Castings
87 Carburizing of Steels
88 Welded and Brazed Parts
89 Aluminum Bronze
91 Glass-Reinforced Plastics
92 Malleable Iron Castings
93 Magnetic Materials
94 Welding the Stainless Steels
95 Rubber Parts

Inexpensive

The above manual reprints are available at a cost of only 25¢ per copy for a short time only since supplies are dwindling rapidly.

Order Now

Return the handy coupon below to secure your copies. Circle the numbers in which you are interested and send 25¢ for each copy ordered. Hurry!

MATERIALS & METHODS
330 West 42nd Street
New York 36, N. Y.

Please send me.....copies each of the following manual reprints:

61	62	63	64	65	67	68	69	70
71	72	73	74	75	76	77	79	80
81	82	83	84	85	86	87	88	89
91	92	93	94	95				

Send to:

Name .....Title .....

Company .....

Street .....

City .....

The Editor's Page

New Occupation

It probably won't be long until every cigarette factory that amounts to anything will have a plant metallurgist. Why? Well, it has recently been determined that manganese and boron have definite effects upon the nicotine content of tobaccos. Researchers of Columbia University recently concluded that metallic elements in the soil in which tobacco is grown affect the properties of that weed the same as they affect the properties of steel, when properly used. Restricting the manganese decreases the nicotine content, and restricting boron increases nicotine content. When this news reaches the high-powered advertising boys, we can expect an entirely new trend in cigarette advertising. I can see it now: Instead of a white-coated doctor, we will see a metallurgist in the 4-color ads being quoted: "Yes sir, I have analyzed all leading cigarettes and find that Fortunate Blows are lowest in manganese and higher in boron than any other cigarette. The difference is in a new heat treating process that removes all the tobacco and leaves pure boron. Try them today."

Poor Us

According to a recent news release from the Dept. of Commerce, magazine production is considered expendable in the event of atomic warfare —and to think that an Industry Advisory Committee agreed to that conclusion. Perhaps we did make a bad choice in becoming an editor instead of a miner.

Time for Aluminum

Speaking of tradition and things old, the time-mellowed city hall clock in Wichita, Kansas, recently had its face, or more properly, its hands lifted. It seems that the clock was originally fitted with wooden hands. The softness of the wood made a nice toe-hold for the claws of an exploratory bird. He told his friends about it. Soon the fast traveling news resulted in a slowing of the clock. The combined weight of the birds and their roost was just too much for the clock's mechanism to cope with, and the result was a stopped clock. To give Wichita the right time, aluminum hands took over as a replacement for wood, and now the birds are unhappy. They can't get a claw-hold in the aluminum and fall off the hands as time marches on.

Higher Production Needed

Canada gives promise of being one of the most important nations on earth. Nearly everyday we hear of some important new resources being uncovered or developed there. The scarcity of one national resource throws a cloud over an otherwise bright future. In the words of H. G. Hilton, president, The Steel Co. of Canada, "We need every Canadian we can produce and many more people besides." Perhaps a Canadian productivity team should visit China or India or some other overpopulated area to see what they can learn.

A Star in Our Crown

We think we showed admirable restraint in avoiding any reference to the recent British Coronation until this time. Outside of the fact that we had no reasons for any such references, there were other reasons. The nation's daily press, radio and television—at least in the New York area—so overplayed the event that we sought some refuge, a place where nary a word was to be found. So we provided one for ourselves. Lest our British friends think we are belittling that historic event, we hasten to assure them that we think such historic pageantry is wonderful. Our criticism is against American mediums of communication, all of which could have used some of the traditional British restraint in handling the story. But then we seem to overdo any notable subject.

T. C. Du Mond
Editor